CHAPTER 4

THE COMPUTER DISPLAY SET AN/UYQ-21 (v)

INTRODUCTION

The Computer Display Set AN/UYQ-21(V) is installed on CV/CVNs, LHDs, AEGIS, and New Threat Upgrade Platforms. Because the AN/UYQ-21(V) is a modular system, its elements can be combined in a variety of configurations to meet the mission requirements of the user. If the user's requirements change, the configuration can be changed with the addition of new elements.

In this chapter, you will learn about the basic configurations and functions of the Computer Display Set AN/UYQ-21(V).

After completing this chapter, you should be able to:

- **State the purpose of the Computer Display Set AN/UYQ-21(V)**
- **Describe the functions and operations of the central equipment group (CEG) components**
- **Describe the function and operation of the sensor data distribution switchboard (SDDS)**
- **Describe the function and operation of the different types of display consoles used in the AN/UYQ-21(V) system**
- **Describe the function and operation of the television converter group (TVC) equipment**

The AN/UYQ-21(V) display system provides for the display of tactical information to enhance combat systems performance. Three types of tactical information can be displayed by the AN/UYQ-21(V) system. These are computer-generated data, sensor data (radar, sonar, IFF, etc.), and television data. The operators use this data for the following purposes:

- Detection, tracking, identification, and evaluation of contacts
- Assignment and control of onboard weapons systems
- Assignment and control of other weapons systems (such as aircraft) via radio and data links

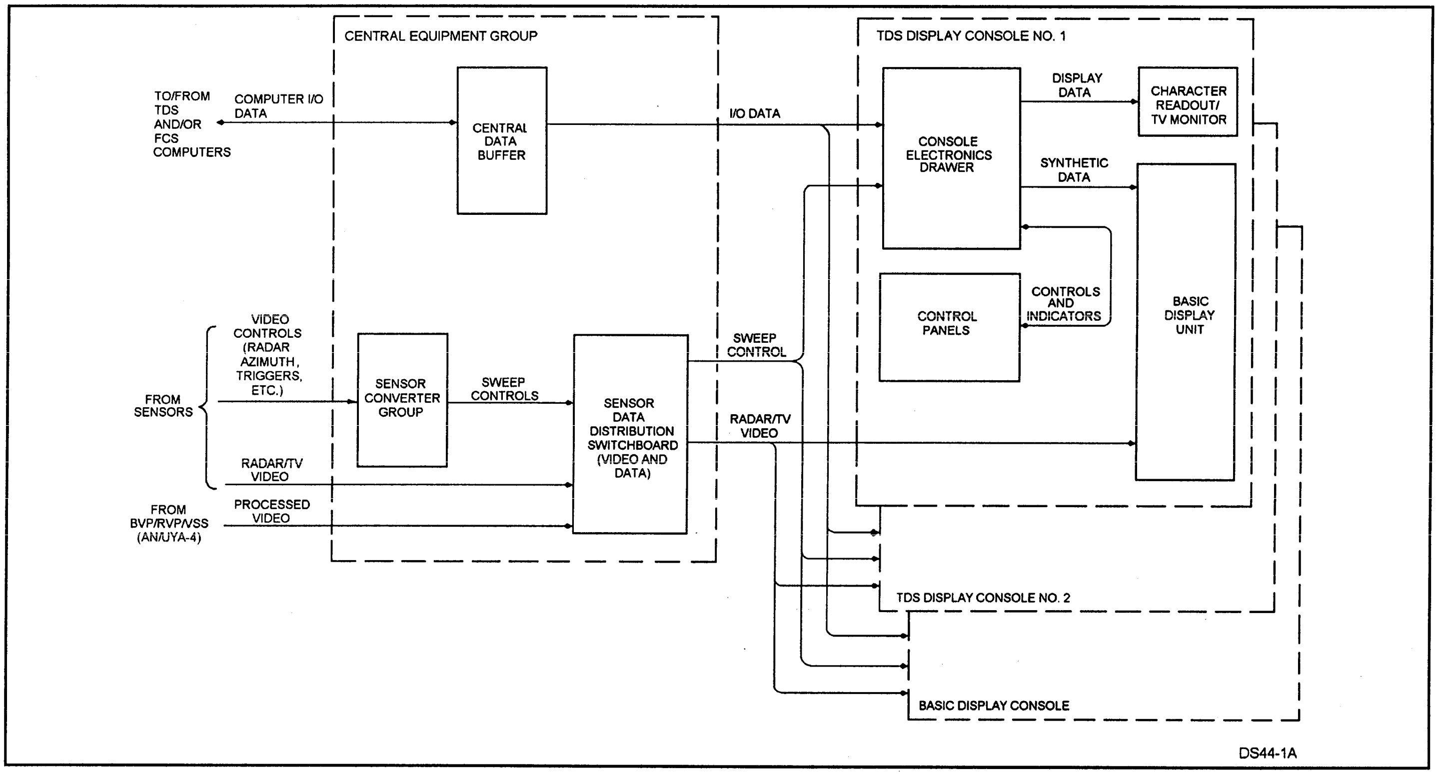

Figure 4-1.–An AN/UYQ-21(V) tactical system configuration block diagram.

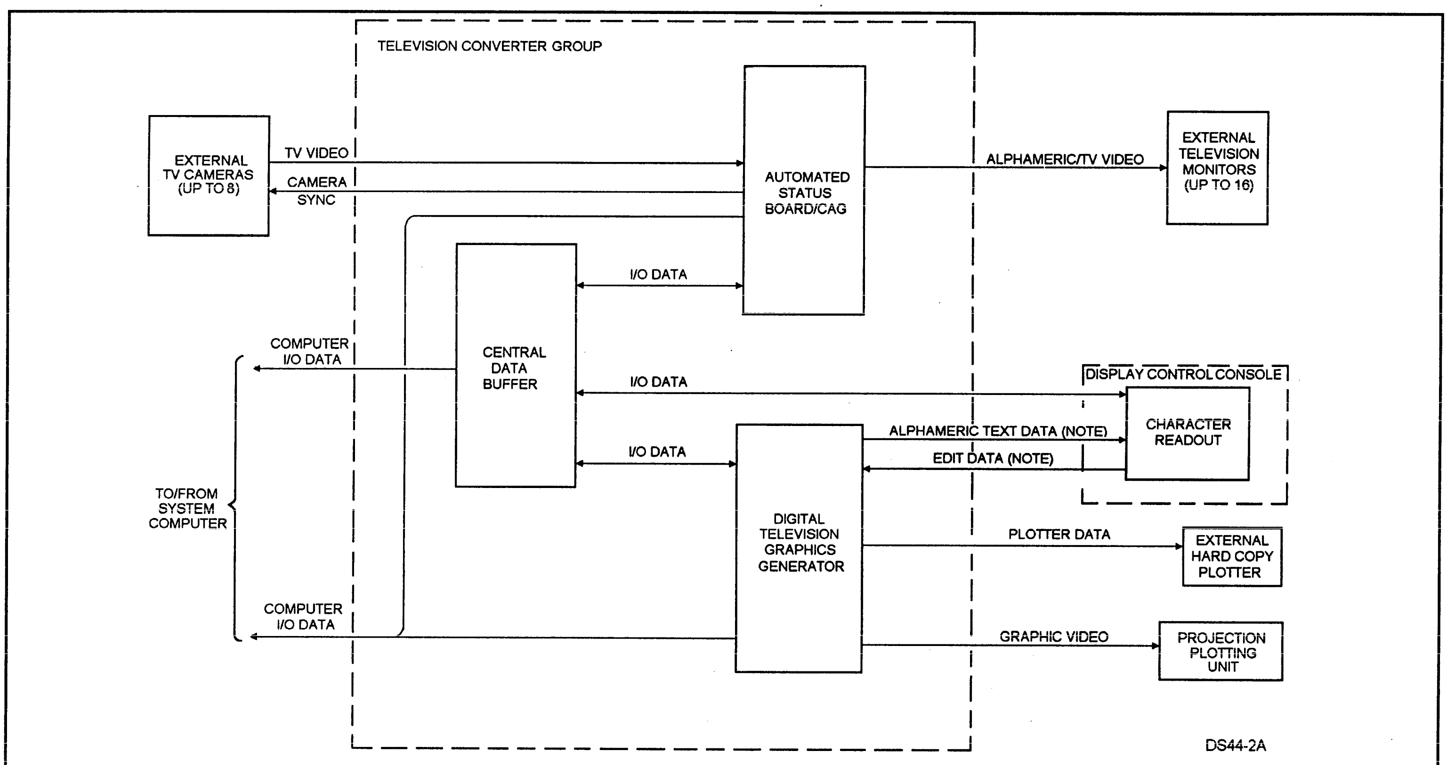

Figure 4-2.–An AN/UYQ-21(V) command system configuration block diagram.

The Computer Display Set AN/UYQ-21(V) can also display remote tracks from other ships and aircraft obtained through data links. Though much of the information is computer controlled, the display console provides the operator with the necessary interface for decision making. The Computer Display Set AN/UYQ-21(V) can be configured to operate as part of a tactical data system (CDS, ACDS), command and control system, or antisubmarine warfare (ASW) system. The ship's mission determines the complement of equipment required.

Figures 4-1, 4-2, and 4-3 show typical configurations for a tactical system, a command system, and an acoustic system, respectively. The different systems can be combined to meet the requirements of the particular platform. The configurations for each system are slightly different. We selected the tactical configuration to discuss in this chapter.

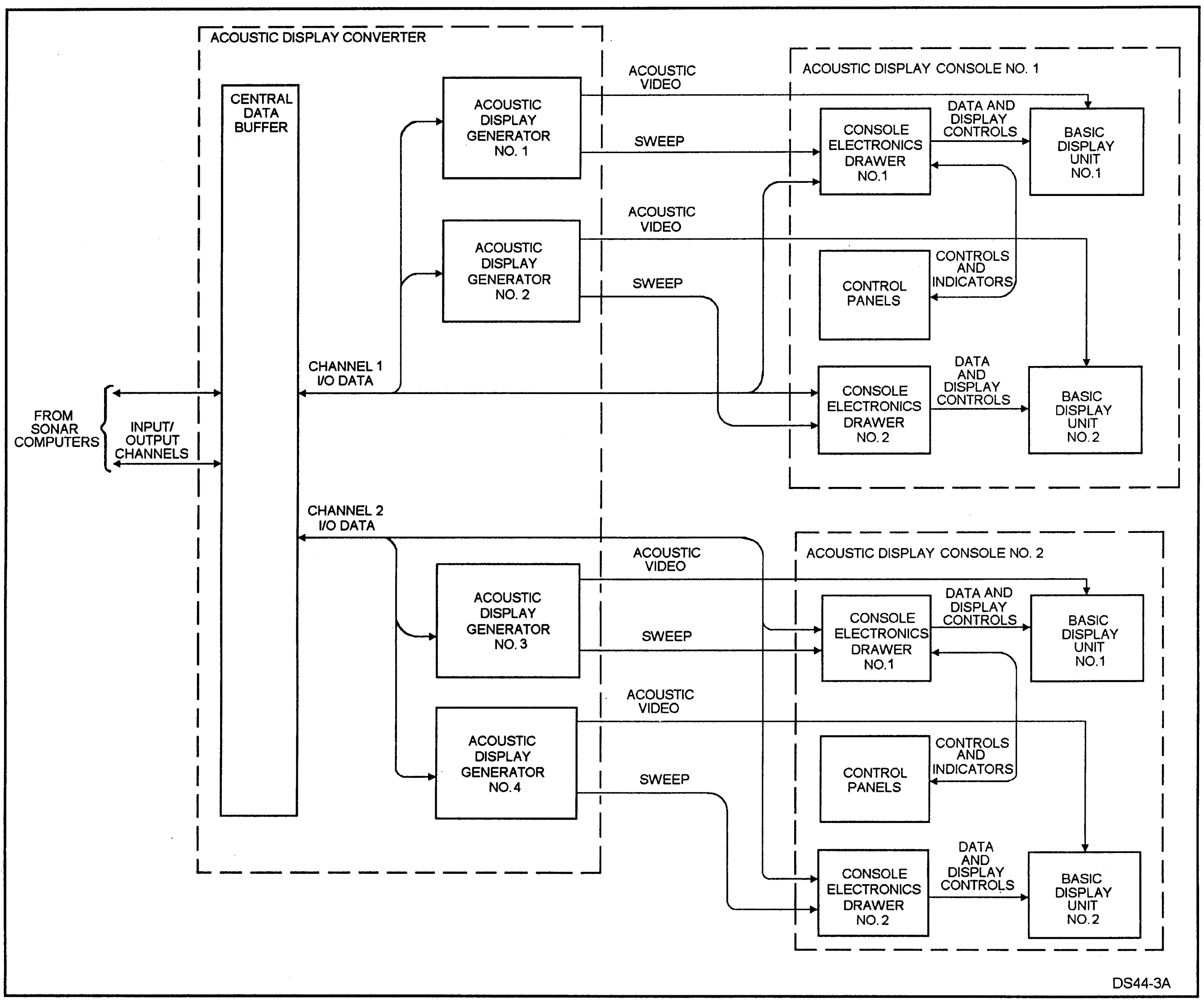

Figure 4-3.—An AN/UYQ-21(V) acoustic system configuration block diagram.

CENTRAL EQUIPMENT GROUP (CEG)

The Central Equipment Group (CEG) is composed of a basic cabinet and power supply that can accommodate up to five equipment modules. Typical equipment modules contained in the CEG are the central data buffer (CDB), the sensor converter group (SCG), the sensor data distribution switchboards (SDDSs), and the analog switchboard. A typically configured CEG, housed in the basic AN/UYQ-21 equipment cabinet, is shown in figure 4-4. One CEG is capable of driving up to 16 tactical data system (TDS) display consoles; converting sensor azimuth, elevation, and range data into a digital X- and Y-sweep data format; and switching sensor data from up to 24 inputs to 40 display units.

CENTRAL DATA BUFFER (CDB)

The central data buffer (CDB) provides the interface between the computer and the display groups. The CDB converts parallel computer data to serial data for use by the display consoles. The CDB distributes data from the computer to the display groups in real time using high-speed multiplexing.

The CDB has three functional areas as shown in figure 4-5. They are the computer interface unit (CIU), the scanner control circuits, and the display multiplexer unit (DMU). One CIU is required for each computer in the system. A fully configured CDB can have four DMUs.

Computer Interface Unit

The computer interface unit (CIU) provides the interface between the system computers and the DMUs. Conversion of the parallel computer data to serial data for use by the display consoles is accomplished in the CIU. The CIU also receives serial data from the display consoles, via the DMU, converts the data to parallel, and sends it to the computer. The CIU can be simultaneously connected to all four DMUs by the system computer (auto mode) or manually from the front panel control switches.

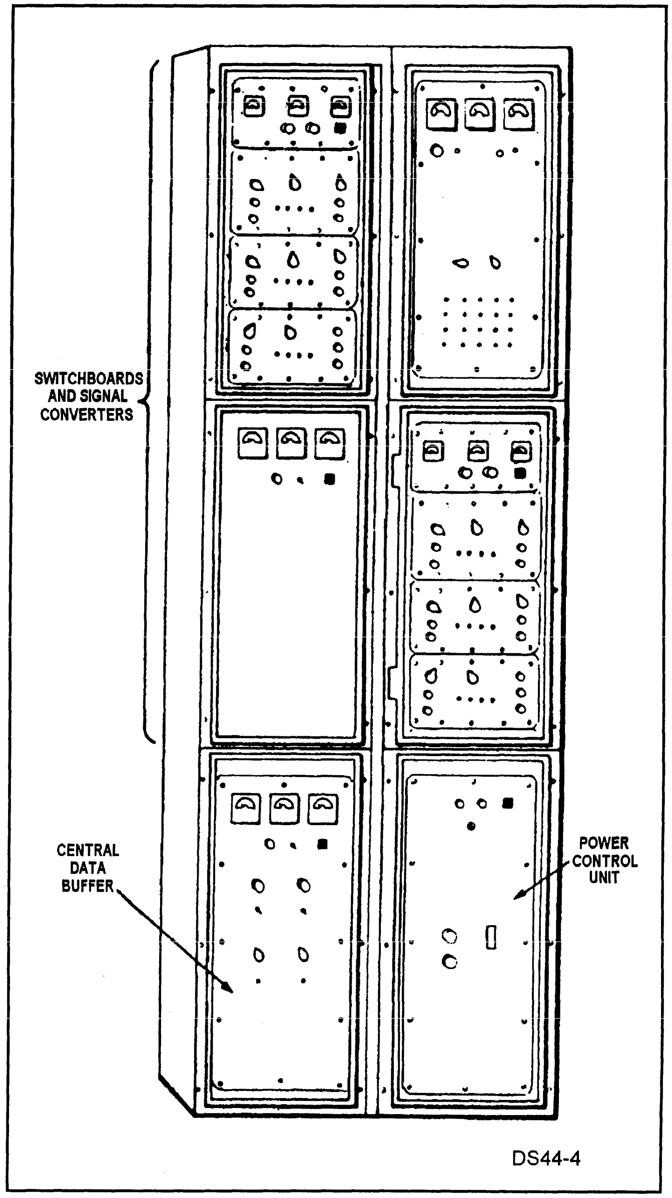

Figure 4-4.–A typically configured central equipment group (CEG).

Display Multiplexer Unit (DMU)

The display multiplexer unit (DMU) transfers serial data between the CIU and the display consoles. Computer output data is received from the CIU in serial form and buffered to provide final drive to the display consoles. Serial data from the display consoles is buffered by the DMU and transferred to the CIU.

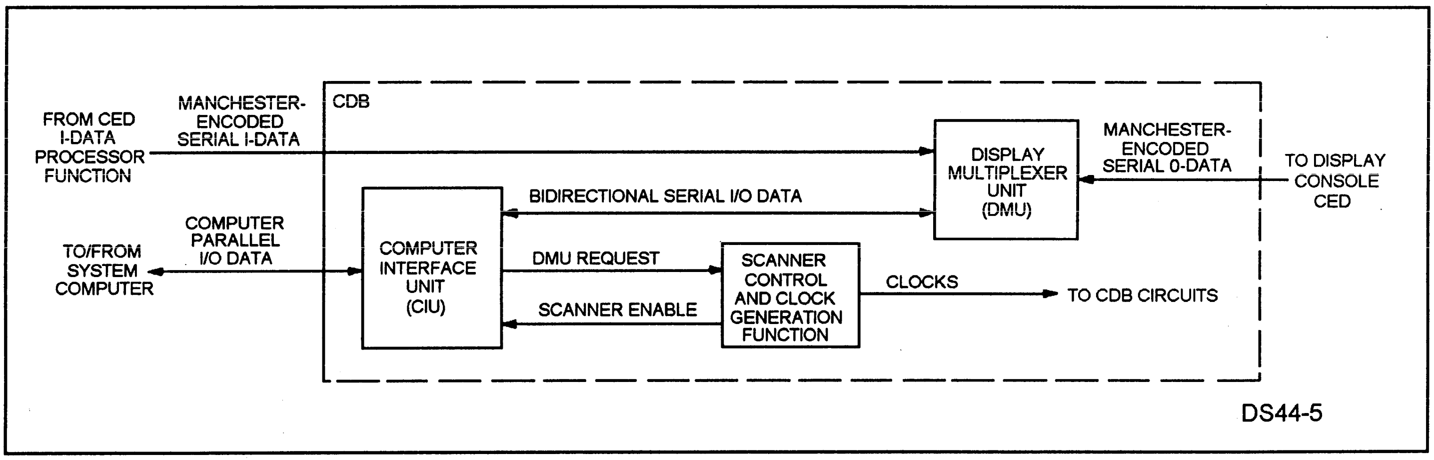

Figure 4-5.—Central data buffer (CDB) functional block diagram.

Scanner Control and Clock Generation

The scanner control and clock generation function provides the controls to connect the CIU to a DMU. A scanner enable signal is generated and sent to a CIU. If the CIU needs to be connected to a DMU, it generates a DMU request. The scanner and clock generation function will connect the requested DMU to the requesting CIU for data transfer. The scanner and clock generation function also generates all system clocks used by the CDB.

CDB Front Panel

The CDB front panel is shown in figure 4-6. The front panel provides the power control and monitoring. The four display channel switches are used to select the display source data. In the AUTO position, any computer can automatically interface with the CDB. If the switch is set to select a particular computer, that computer will be the only data source. The CDB can be tied to six computers; therefore, the computer 7 and the computer 8 positions are not used.

Display channels 1 and 2 can be tied to the same data source when required by placing the DATA SOURCE SELECT switch in the BACKUP position. If you want display channel 1 to use the same data source as display channel 2, place the display channel 1 DATA SOURCE SELECT SWITCH in the BACKUP position. For display channel 2 to use display channel 1's data source, place the DISPLAY

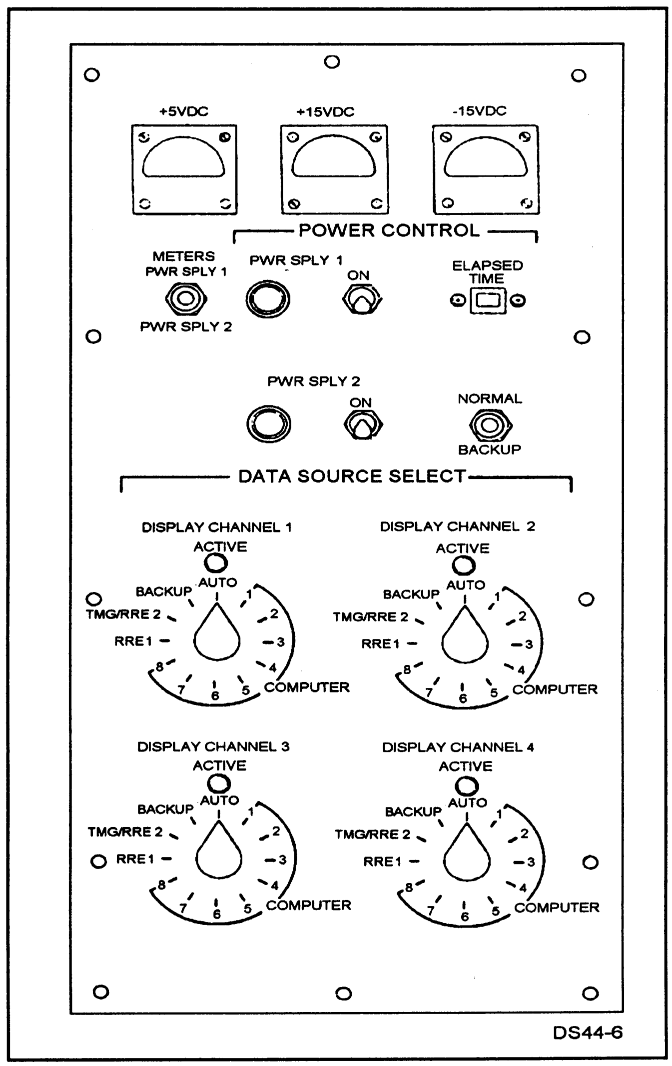

Figure 4-6.—Central data buffer (CDB) front panel.

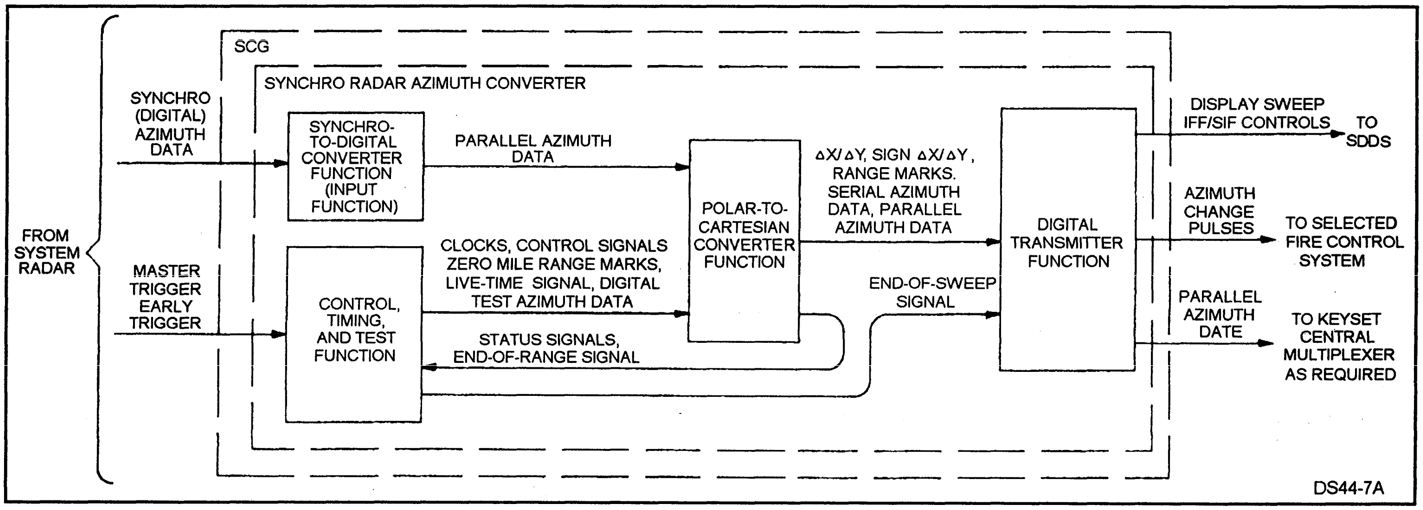

Figure 4-7.–Radar azimuth converter functional block diagram.

CHANNEL 2 DATA SOURCE SELECT switch in the BACKUP position. Display channels 3 and 4 are tied together in the same way.

SENSOR CONVERTER GROUP (SCG)

The sensor converter group (SCG) of the CEG is the main interface between the system radars and the display consoles. The SCG consists of three synchro radar azimuth converters (SRACs) or two SRACs and one digital radar azimuth converter (DRAC), located in one drawer of the CEG.

Each SRAC or DRAC provides the interface for one radar. The SRAC receives azimuth data and triggers from a synchro radar and generates the signals required to display sweep and range marks on the display console. The DRAC performs the same function with signals from a digital radar. The SRAC consists of four fictional areas as shown in figure 4-7. These fictional areas are:

- synchro-to-digital converter
- control, timing, and test circuits
- polar-to-Cartesian converter
- digital transmitter

The DRAC is similar to the SRAC except the synchro-to-digital converter is replaced with the input functional area.

Synchro-to-Digital Converter Function

The synchro-to-digital converter receives 60-Hz or 400-Hz synchro azimuth data from the radar and converts it to a 12-bit digital value that is sent to the polar-to-Cartesian converter.

INPUT FUNCTION.– The input function, used only in the DRAC, receives digital azimuth data from a digital radar and converts it to TTL levels. The azimuth data consists of 11 bits representing the absolute value of sin θ/ cos θ and 1 bit representing the sign. The input function retransmits the azimuth data received back to the radar for error checking.

CONTROL, TIMING, AND TEST FUNCTION.– The control, timing, and test fiction produces the signals that control the operation of the polar-to-Cartesian conversions, provides the system clocks for the converter, and produces digital test azimuth for the self-test functions.

POLAR-TO-CARTESIAN CONVERTER FUNCTION.– The polar-to-Cartesian converter function converts the parallel azimuth data from the synchro-to-digital converter to ΔX and ΔY pulse trains and sign of ΔX/ sign of ΔY. The 10 LSBs of the azimuth data are decoded for ΔX/ΔY position and the 2 MSBs are decoded for quadrant data to form the sign of ΔX/ sign of ΔY. In self-test mode, the azimuth data is generated by the control, timing, and test function. The polar-to-Cartesian converter also produces range marks.

DIGITAL TRANSMITTER FUNCTION.— The digital transmitter function transmits the sweep data to the sensor data distribution switchboard. This data is the ΔX/ΔY pulse trains, sign of ΔX and sign of ΔY, range marks, end-of-sweep, and analog azimuth signals. The digital transmitter function also sends parallel azimuth data to the system's computer via a multiplexer.

SRAC CONTROL PANEL.— The SRAC control panel allows the operator to monitor and control the operation of the SRAC. Figure 4-8 shows the SRAC control panel. For normal operation, the MODE switch must be in the OPERATE position. If the MODE switch is in the CONTINUOUS position, timing and azimuth data are generated by the control, timing, and test function. Sweep rotation is

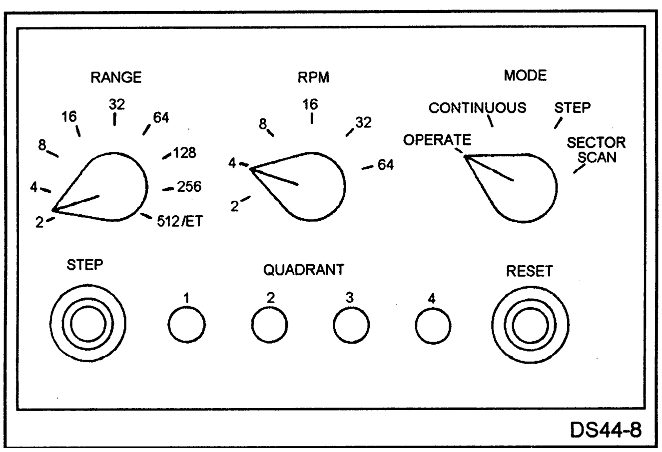

Figure 4-8.—The SRAC control panel.

continuous and clockwise. Speed of the simulated sweep is controlled by the RPM switch. The STEP mode enables use of the STEP pushbutton. The azimuth of the simulated sweep is incremented one time for every depression of the STEP pushbutton. In the SECTOR SCAN mode, a 45-degree simulated sweep is generated that alternately scans clockwise and counter-clockwise. The RANGE switch is normally in the 512/ET position, but maybe placed in the desired range to generate an internal end-of-sweep signal. The control panel for the DRAC is identical to the control panel for the SRAC.

SENSOR DATA DISTRIBUTION SWITCHBOARD (SDDS)

The sensor data distribution switchboard (SDDS) distributes azimuth data from the RAC and video from the radar to the display consoles. The SDDS occupies two drawers in the CEG. One drawer is the sweep/passive or sweep/IFF SDDS. The other drawer is the video SDDS. The SDDS can route inputs from up to 12 sensors to 20 display consoles. The SDDS can be expanded to provide outputs to 40 display consoles by installing two of each drawer in the CEG. A block diagram of the SDDS is shown in figure 4-9.

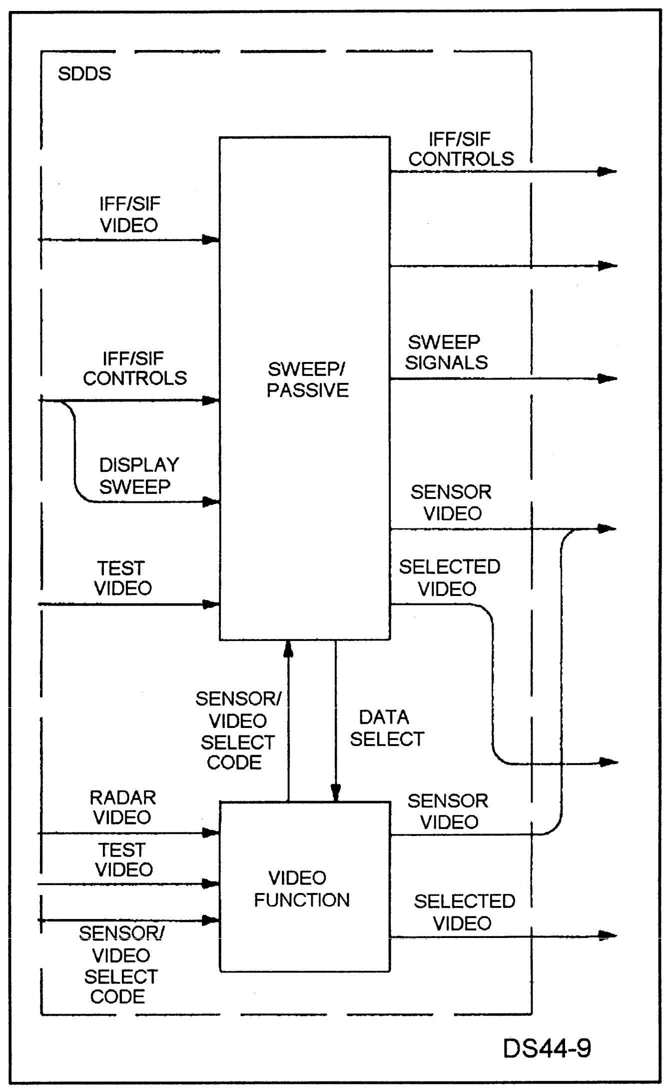

Figure 4-9.–The sensor data distribution switchboard.

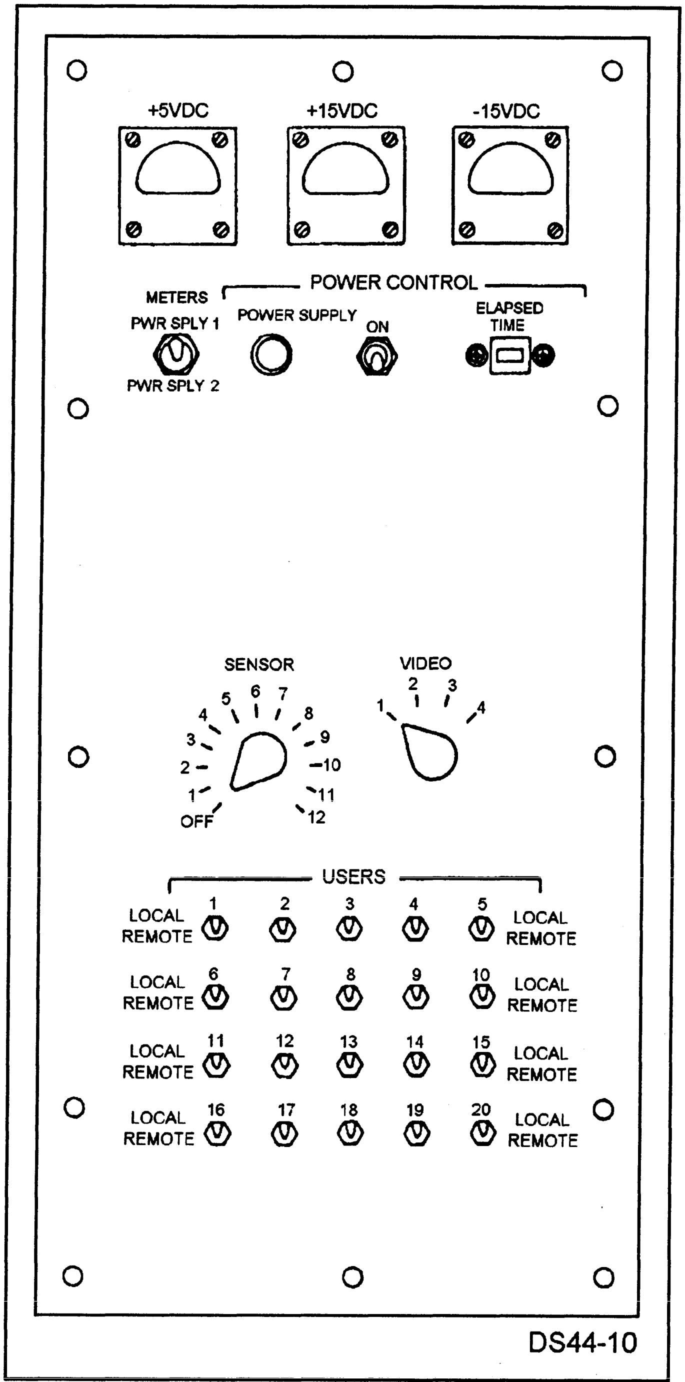

Figure 4-10.—The front panel for a sweep/passive sensor data distribution switchboard (SDDS).

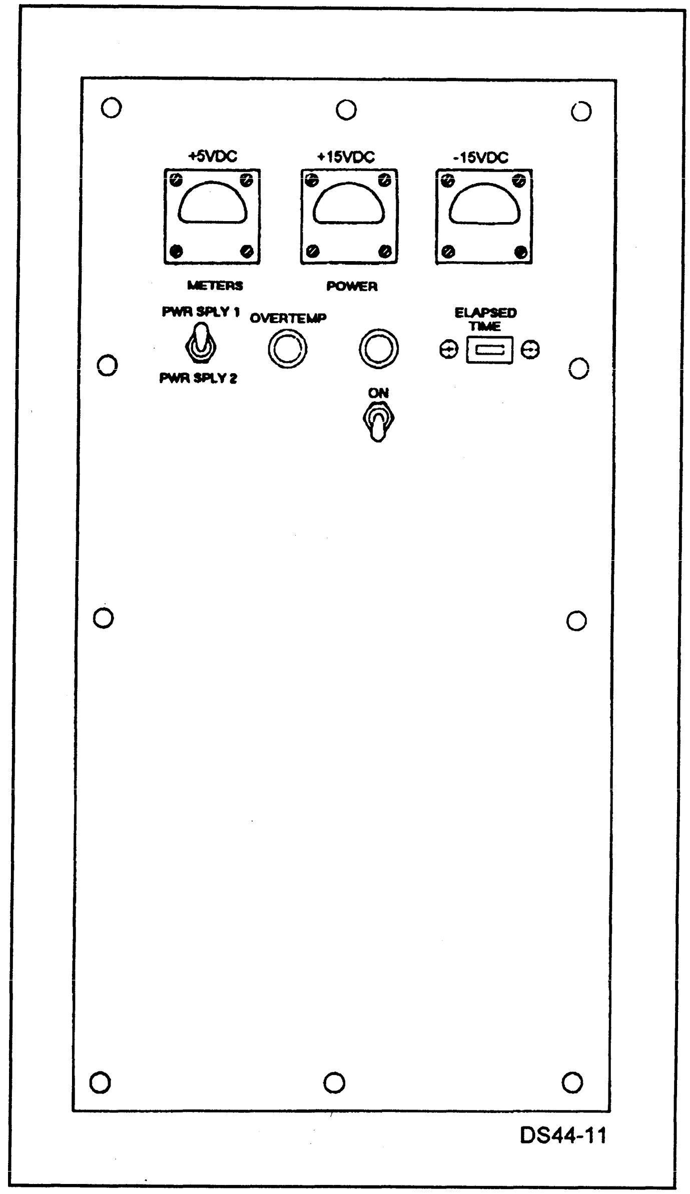

Figure 4-11—The front panel of the sweep/IFF SDDS.

Sweep/Passive and Sweep/IFF Functions

The sweep/passive function of the SDDS receives radar and video select signals from the display consoles via the video drawer, and receives sweep data from the SCG. The sweep/IFF function receives the same inputs as the sweep/passive drawer and also receives identification, friend or foe/selective identification feature (IFF/SIF) video and control signals. The operation of both the sweep/passive function and the sweep/IFF function is similar. The sweep/passive function decodes the radar and video select signals from the display consoles or the CEG front panels and routes the proper radar sweep and IFF/SIF video back to the console. The sweep/passive function also sends the radar and video select signals to the video function SDDS as the data select signal.

Video Function

The video function receives composite video from the selected sensor, and routes it to the requesting display console. The video function amplifies the video signals to the proper level to drive the video through a maximum of 1,000 feet of cable for each output.

SDDS Front Panels and Controls

The sweep/passive function SDDS front panel is shown in figure 4-10. The front panel contains three power meters to allow for monitoring of the power supply outputs. The 20 user toggle switches allow the operator or technician to locally select the sensor and video that are routed to a particular display console or group of consoles. When the toggle switch is in the LOCAL position, the associated console will receive sweep and video data selected by the SENSOR and VIDEO rotary switches. When the toggle switch is in the REMOTE position, sensor and video selection is controlled by the switches on the display console. The front panel for the video function SDDS is very similar to the passive/sweep function front panel. The front panel for the sweep/IFF function SDDS is shown in figure 4-11. All switches for the sweep/IFF function drawer are controlled by the video function drawer.

DISPLAY CONSOLES

The Computer Display Set AN/UYQ-21(V) can use several different types of display consoles, depending on the function of the console and the system in which the console is installed. The consoles include the TDS Display Console OJ-451(V)/UYQ-21(V), the Display Control Console OJ-535(V)/UYQ-21(V), and the large screen Display Projection Plotting Unit PT-525/UYQ-21(V).

TDS DISPLAY CONSOLE OJ-451(V)/UYQ-21(V)

The TDS display console is the basic operator interface with the operational program. The TDS console is capable of displaying symbols, graphics, and sensor sweep and video. There are several versions of the TDS display console. The one we are using as a training model is the OJ-451(V)9/UYQ-21(V). It is shown in figure 4-12. It is important to remember that the information in this training manual is designed only to give you a basic understanding of the equipment and is not intended to replace-the technical ‘manuals.

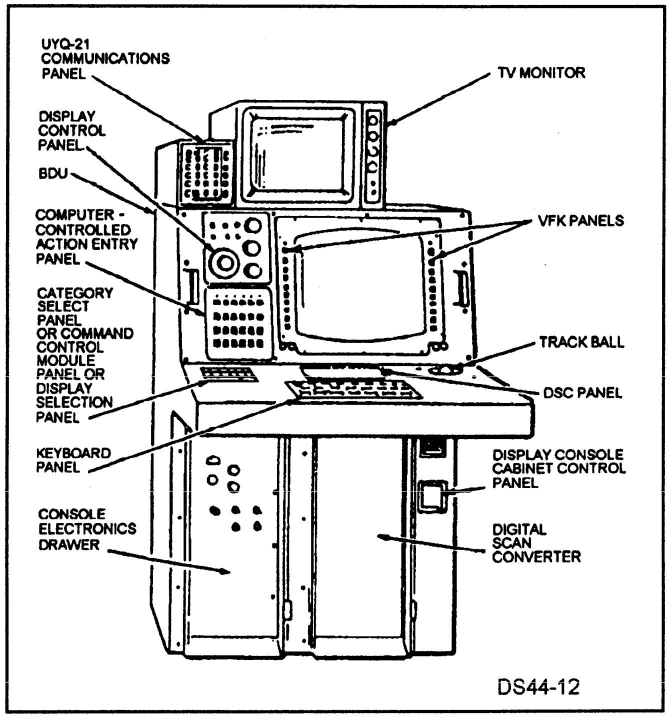

Figure 4-12.—The TDS Display Console OJ-451(V)/UYQ-21(V).

The TDS display console consists of the computer display console, a basic display unit (BDU), a TV monitor (CRO), and a communications station. The computer display console consists of the operator control panels and the console electronic drawer (CED), which contains the circuitry to control the operation of the console. The BDU is common is all versions of the TDS display console and serves as a display device for computer-controlled symbols and sensor sweep and video. The TV monitor displays alphanumeric data.

Computer Display Console

The computer display console is the main operator interface for displaying sensor data and communicating with the operational program. The computer display console receives sensor data from the SDDS or the digital scan converter (DSC). It receives symbol, graphic, and alphanumeric data, in encoded serial format, from the system computer via the CDB. The display console can also be configured to receive parallel data directly from the system computer. The display console converts the symbol, graphic, and sensor data into coordinate data and sends this data to the BDU for display on the CRT. The alphanumeric data is converted into a composite video data for display on the TV monitor. The computer display console consists of the following 15 functions:

- O-data receiver function
- Input/output processor function
- Memory sort processor function
- System memory function
- Graphics processor function
- Display generator function
- Panel processor function
- Sweep and raster function
- Digital deflection function
- Clock generator function
- TV monitor display generator function
- Computer-controlled action entry panel (CCAEP) function
- I-data storage and control function
- I-data transmitter function
- Diagnostic function

The four processor functions contain microprocessors. When power is turned on, each microprocessor runs a diagnostic check of its respective functions, then downloads its program to system memory. The processors receive and store data, communicate with each other, and transfer data via system memory and buses. Only one processor function at a time can access the system buses.

O-DATA RECEIVER FUNCTION.— The O-data receiver function interfaces the display console with the CDB. It receives the encoded serial data from the CDB, decodes it to serial data, and sends the data to the I/O processor function. Parallel data received from the system computer is buffered and sent to the I/O processor.

INPUT/OUTPUT (I/O) PROCESSOR FUNCTION.— The input/output processor function controls all communications with the system computer. It receives data from the O-data receiver function and distributes the data throughout the display console. It also buffers the O-data and sends the buffered O-data to the BDU.

MEMORY SORT PROCESSOR FUNCTION.— The memory sort processor function controls the operation of the system memory. It provides memory management by sectioning the refresh memory, checking the refresh memory for changes, clearing memory, and checking for page enabling and end-of-page codes. The memory sort processor function also updates trackball data and commands the graphics processor function.

SYSTEM MEMORY FUNCTION.— The system memory function is used for storage of the processor programs and for temporary storage of data. The system memory contains 128K of RAM for use by the display console. The system memory function also controls the use of the data buses by the other functions of the console.

GRAPHICS PROCESSOR FUNCTION.— The graphics processor function converts processed refresh memory data, from the system memory, into display data. This display data is sent to the display generator.

DISPLAY GENERATOR FUNCTION.— The display generator controls the display of all types of symbols on the basic display unit. Display data from the graphics processor is received by the display generator and decoded. The appropriate deflection, intensity, and timing signals are generated and sent to the BDU. The display generator can display symbols, circles, ellipses, and lines in four intensities and four colors.

PANEL PROCESSOR FUNCTION.— The panel processor function monitors and controls the various operator panels on the display console. It receives data from various switches and forms the I-data words. The panel processor function also lights the various lamps in the 6 x 7 switch panel, variable function key (VFK) panel, and system keyboard. It accumulates trackball data for proper positioning of the ball tab. The panel processor converts the X/Y coordinates of the trackball to range and bearing data (R- If the operator activates range and bearing display, the console will display range and bearing of the ball tab from the point that the ball tab was enabled. During diagnostics, the panel control processor generates diagnostic controls and flags. It compiles graphics data and generates sweep and display control signals.

SWEEP AND RASTER FUNCTION.— The sweep and raster function generates the signals necessary for the proper display of sensor sweeps. It receives display sweep signals from the SDDS. The sweep and raster function also receives offset data, range settings, sensor selected, sensor mode, and video level selected from the panel processor. The sweep and raster function generates the sweep and raster intensity controls for the BDU. It also generates sensor and video codes for the SDDS, and sweep deflection control and offset coordinates for the digital deflection function.

DIGITAL DEFLECTION FUNCTION.— The digital deflection function develops X and Y analog deflection voltages for use by the BDU. Digital X and Y symbol coordinates are stored in the X/Y symbol counters. The output of the symbol counters are sent to the X and Y modified monobit digilogs for conversion to an analog voltage. Sweep deflection data is generated by the X and Y sweep counters. The sweep counter receives and counts the ΔX and ΔY pulses. If the sweep is to be offset, the X and Y sweep counters are preset to the offset coordinates. The outputs of the X and Y sweep counters are also sent to the modified monobit digilogs for conversion to analog deflection voltages. The sweep symbol select multiplexer controls whether the sweep coordinates or symbol coordinates are input to the modified monobit digilogs.

CLOCK GENERATOR FUNCTION.— The clock generator function generates the system clock for use by the display console. Clocks are generated from 40-MHz and 24-MHz oscillators. The clock generator function also generates the power-on reset signals at power-on or when the RESET switch is depressed.

TV MONITOR DISPLAY GENERATOR FUNCTION.— The TV monitor display generator function generates analog composite video used to display alphanumeric data on the digital data indicator.

COMPUTER-CONTROLLED ACTION ENTRY PANEL (CCAEP) FUNCTION.— The computer-controlled action entry panel (CCAEP) function interfaces the CCAEP with the display console. When an operator activates a CCAEP switch, the switch data is processed by the CCAEP function into computer I-data. CCAEP O-data from the computer is decoded to generate row and column enables and to light readout lamps.

I-DATA STORAGE AND CONTROL FUNCTION.— The I-data storage and control function forms computer I-data from the various functions and sends data to the system computer in response to an interrogation. Data is received by the I-data storage and control function from the other functional areas of the display console and converted into serial data if a CDB is used in the system. If a CDB is not used, then the I-data is in parallel form and transferred directly to the computer.

I-DATA TRANSMITTER FUNCTION.— The I-data transmitter function converts console I-data from the I-data storage and control function to the levels required for transfer to the system computer. If the data to be transferred is in serial format, the I-data transmitter function converts the serial data

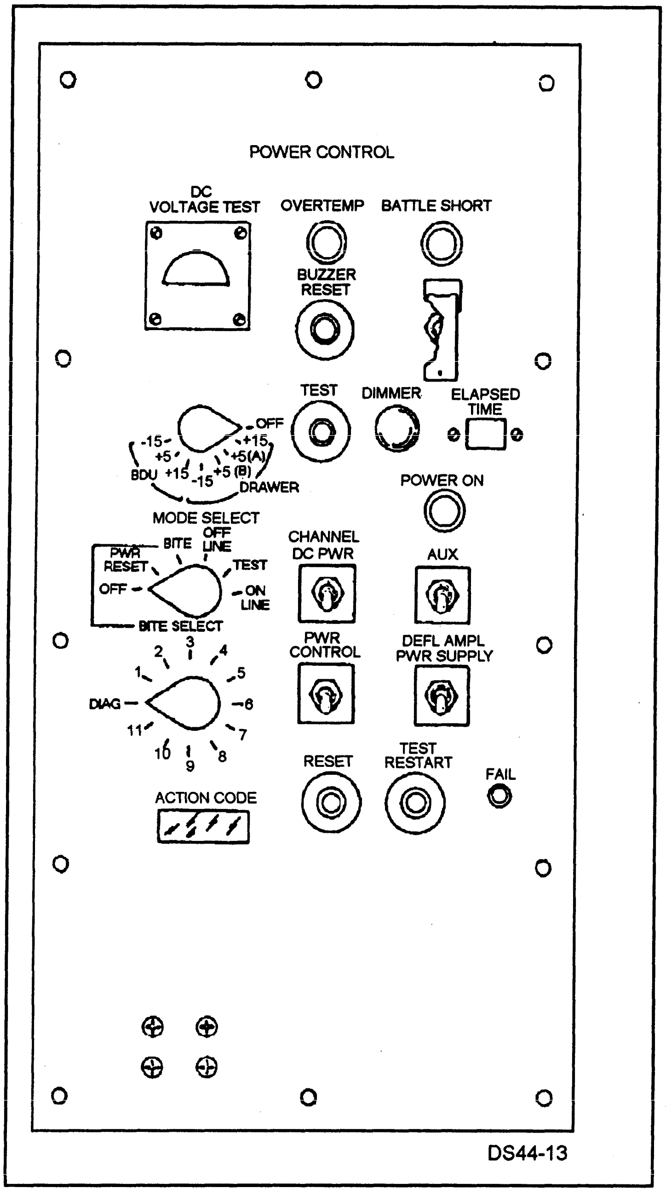

Figure 4-13.—A console electronics drawer power control panel.

into Manchester encoded serial data before transferring it to the CDB. If the data is in parallel format, the parallel data drivers provide the proper level shifting and gating to the system computer.

DIAGNOSTIC FUNCTION.— The diagnostic function controls the running of the various built-in self tests. There are three levels of diagnostic testing. Level I tests are run automatically when the power is turned on. Level I tests are basic checks of the system clocks, memory timing, and operation of the four processors. If no errors are detected during level I tests, the level II tests are run. Level II tests are more detailed and check the system RAM, processor support subfunctions, refresh memory, display memory, and processor interfaces. Level III tests are detailed interactive tests. Level III tests are controlled by the technician and can be run when the power control panel MODE SELECT switch is in the BITE (built-in test equipment) position. Figure 4-13 shows a typical console electronics drawer power and control panel. There are several different power and control panels, but all have similar controls and indicators. If a fault is detected during level I or II testing, the FAIL indicator on the CED power control panel will light. Internal fault indicators, located on the circuit cards, may also be lighted if a level I or II test fails. A numerical code may be displayed in the ACTION CODE readout on the CED power panel for level I, II, or III test failures. For exact operating procedures and fault isolation codes, you should refer to the *Maintenance Instruction Manual for Computer Display Set AN/UYQ-21(V),* Volume 2, SE685-AF-MMM-020/UYQ-21(V).

POWER DISTRIBUTION.— The power distribution function converts the ac input power into +5, +15, and -15vdc for use in the console. The power distribution function also monitors the operating temperature and provides an over-temperature alarm when the console operating temperature reaches 150°F. If the console temperature reaches 170°F, an unsafe condition is present and the console will automatically shut down. The automatic shutdown can be overridden by the BATTLE SHORT switch.

Basic Display Unit

The basic display unit (BDU) is used to display sensor data and computer-controlled symbology. Data input to the computer is accomplished by variable function keys around the CRT. Figure 4-14 illustrates the BDU. The BDU consists of an 11" x 13" vector scan CRT and seven functional areas to support the display, as shown in the block diagram (figure 4-15). The functional areas of the BDU are:

- Input/output function

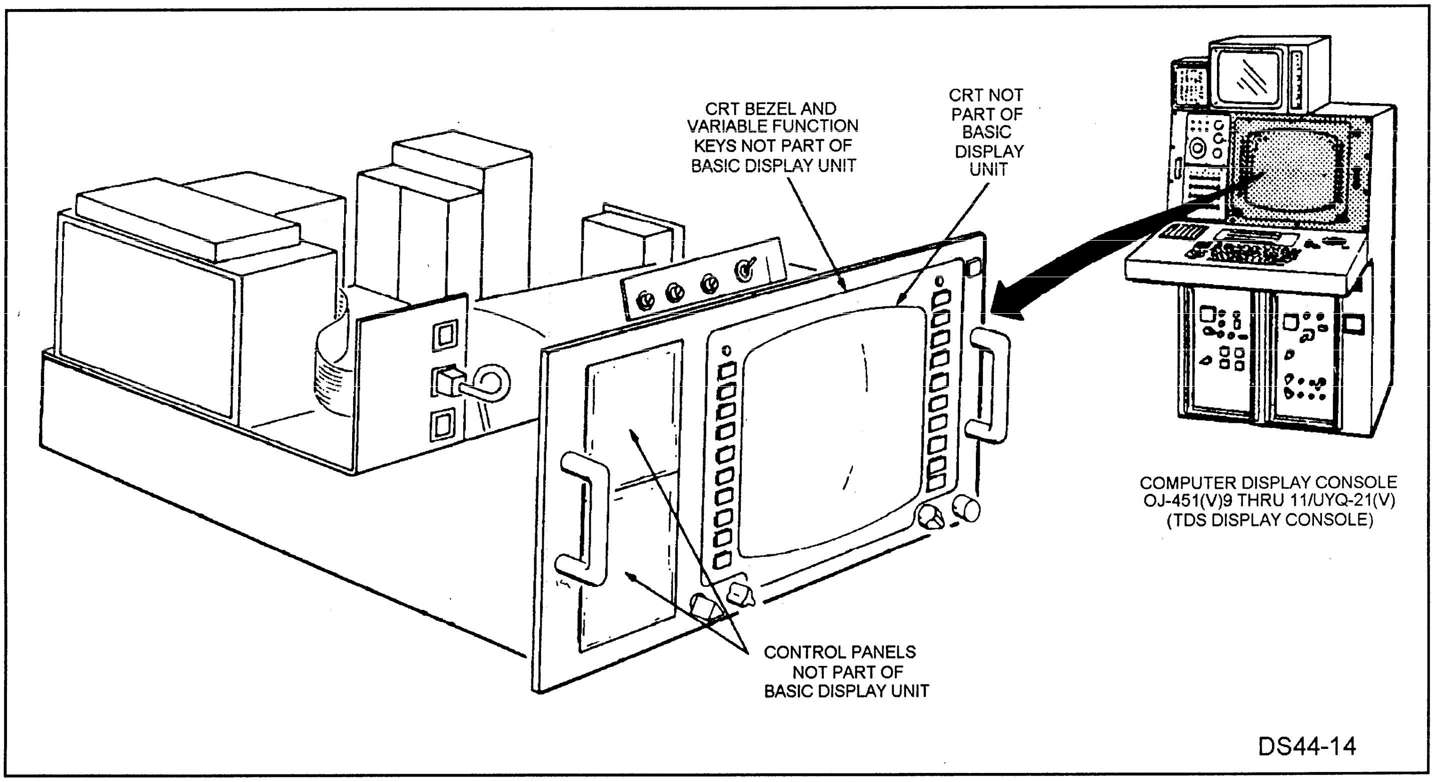

Figure 4-14.—The basic display unit (BDU).

- Symbol generator function
- Conies generator function
- Circular sweep control function
- Analog deflection function
- Intensity control function
- Power distribution function

INPUT/OUTPUT FUNCTION.— The input/output (I/O) function is the interface between the basic display console and the BDU. The I/O function has two subfunctional areas: the input subfunction and the output subfunction.

The input subfunction consists of digital and coax line receivers. The receivers provide for impedance matching and buffering of the input signals. The input function also routes input data to other fictions of the BDU.

The output subfunction of the BDU consists of digital drivers to send symbol status signals back to the display console.

SYMBOL GENERATOR FUNCTION.— The symbol generator function contains the circuitry to generate the symbology and alphanumerics for display on the CRT. Symbols are generated using the stroke method described in chapter 1 of this manual.

CONICS GENERATOR.— The conies generator develops the signals required to display circles and ellipses. Circle radius can be from 16 to 1,023 deflection units in increments of 1 deflection unit. The circle and ellipse data is received from the I/O function. Size of the circle or ellipse is determined and scaled to match the range setting of the display console. Deflection voltages, consisting of sine and cosine waveforms or conies radius, are sent to the analog deflection control function.

CIRCULAR SWEEP CONTROL FUNCTION.— The circular sweep control function develops the signals required to display circular sweep. The function receives the ΔX and ΔY pulse

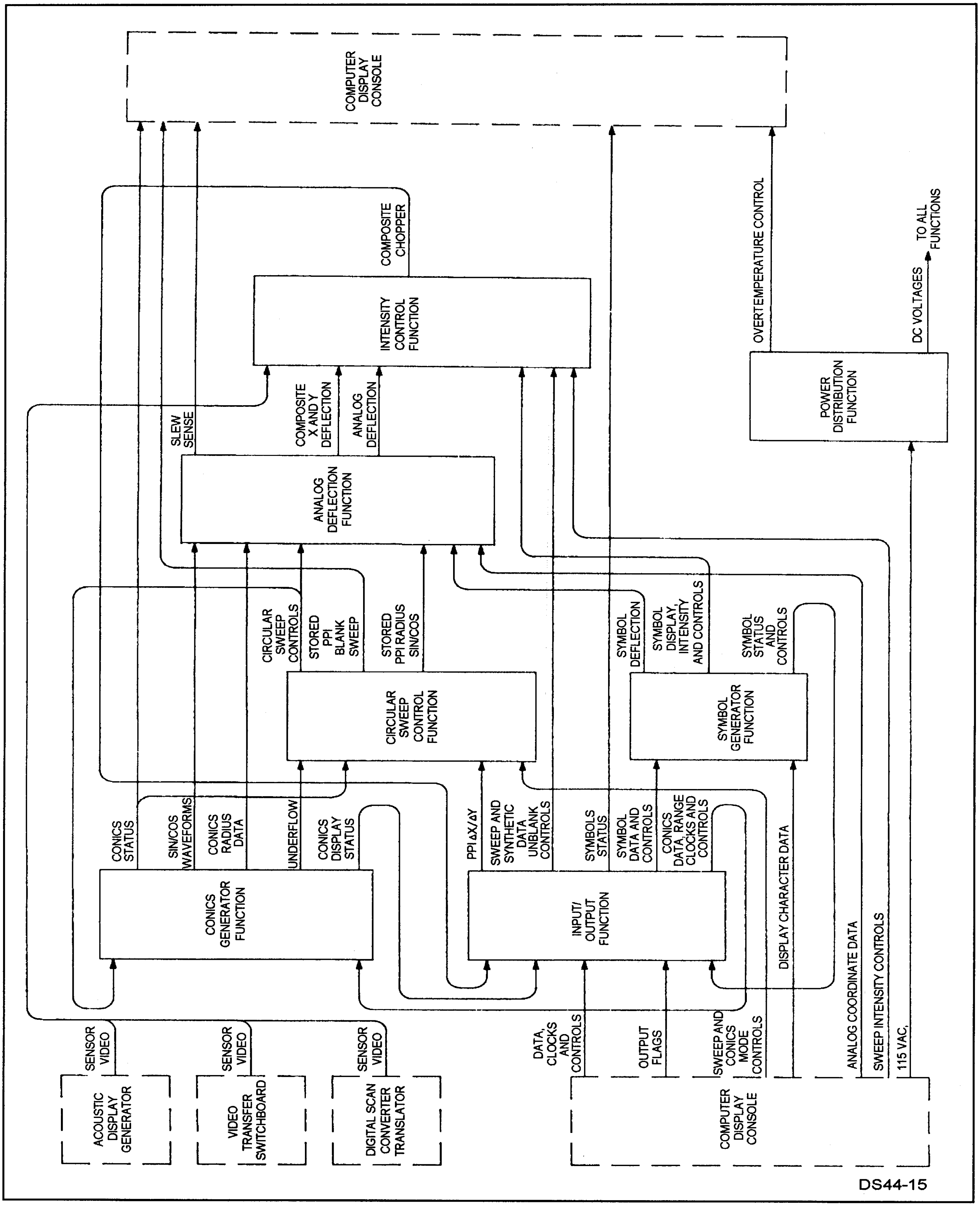

Figure 4-15.—The functional block diagram of the basic display unit.

trains from the RAC, counts the pulses, and develops the deflection voltages required for generating the sweep circular raster.

ANALOG DEFLECTION FUNCTION.— The analog deflection function controls the movement of the CRT beam via the yoke on the neck of the CRT. Major position data is received from the display console and summed with the symbol waveforms from the symbol generator or circle/ellipse waveforms from the conies generator.

INTENSITY CONTROL FUNCTION.— The intensity control function controls the blanking and unblinking of the CRT beam and the brightness of the display. The intensity control function also contains compensation circuitry to ensure the intensity of the display is uniform because of changes in the write time of the display.

POWER DISTRIBUTION FUNCTION.— The power distribution function contains the power supplies to convert the input ac voltage to the levels required by the BDU. Depending on the version of the BDU in use, there are six or seven power supplies in the power distribution function that develop the following voltages: +5, +6.3, +15, -15, +30, +100, +110, +600, +18,000, -26, -30, and -110.

TV Monitor

The TV monitor is a 7" x 9", 525 line, interlaced monochrome monitor mounted to the top of the BDU. It is shown in figure 4-16. The TV monitor has two input channels and displays composite video. The composite video may be computer-generated alphanumeric data, video from another monitor, or a picture from an external video camera. The TV monitor also has a video loop through connection to allow the same information to be displayed on up to five additional monitors. Figure 4-17 shows the block diagram of the TV monitor.

VIDEO CONTROL FUNCTION.— The video control function receives signals from the control panel that allow the operator to control the brightness and contrast of the raster and select which of the two video sources will be displayed on the CRT. The TV

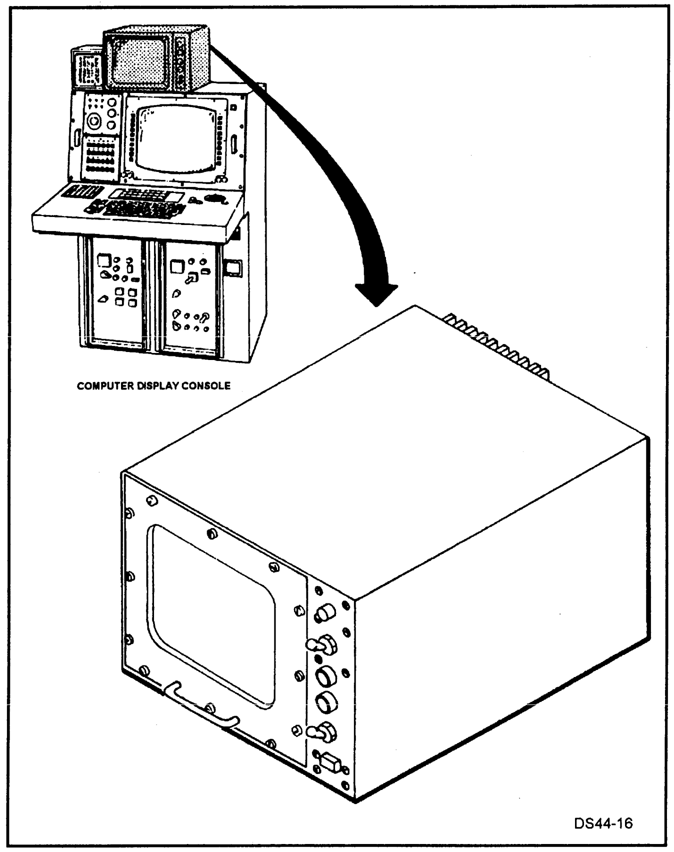

Figure 4-16.–The TV monitor.

monitor control panel is shown in figure 4-18.

The raster control signals and the composite video input signals are used by the video control function to generate the CRT drive signals. The horizontal and vertical blank signals from the sweep generator provide the timing for the video function to blank the CRT during horizontal and vertical retrace.

SWEEP GENERATOR FUNCTION.— The sweep generator function develops the signals to drive the horizontal and vertical deflection yokes and generates timing signals required by the video control function.

DISPLAY CONTROL CONSOLE OJ-535(V)/UYQ-21(V)

The display control console (DCC) OJ-535(V)/UYQ-21(V) is a high resolution graphics console that provides a man-to-machine interface for the display and control of command and control data. Figure 4-19 shows one configuration of the

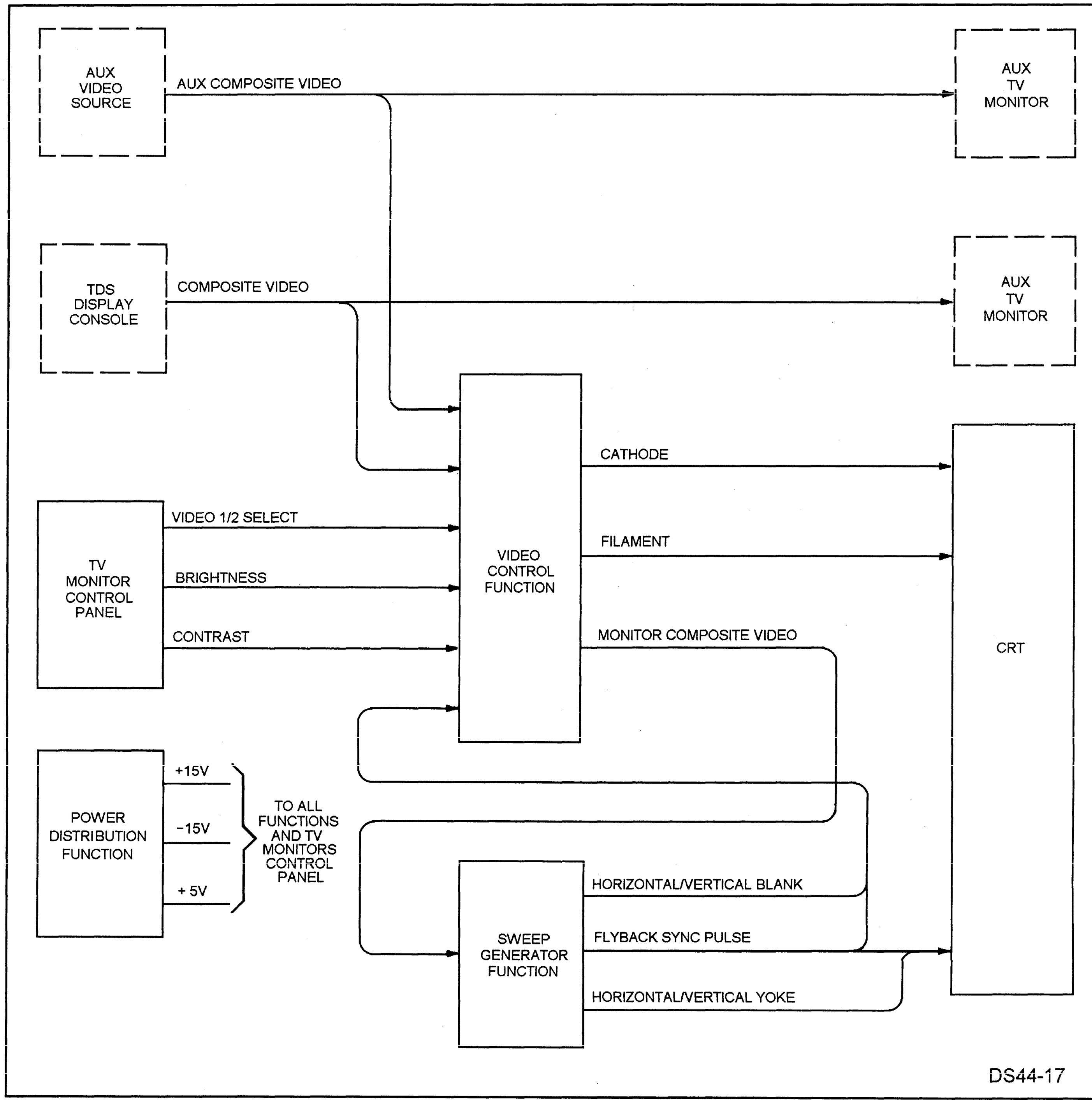

Figure 4-17.—The TV monitor block diagram,

OJ-535(V)/UYQ-21(V). The display control console consists of three modules. The modules are the digital display indicator (CRT display module), the graphics display shelf (bullnose), and the control panel module.

The DCC interfaces with the system computer through a television converter. The television converter can be either the common digital television graphics generator (C-DITEG), the television scan converter (TVSC), or the tactical DITEG module (TDM). These converters are covered later in this chapter. We assume an interface with the C-DITEG in our discussion of the DCC. Figure 4-20 shows the system block diagram of the DCC interface.

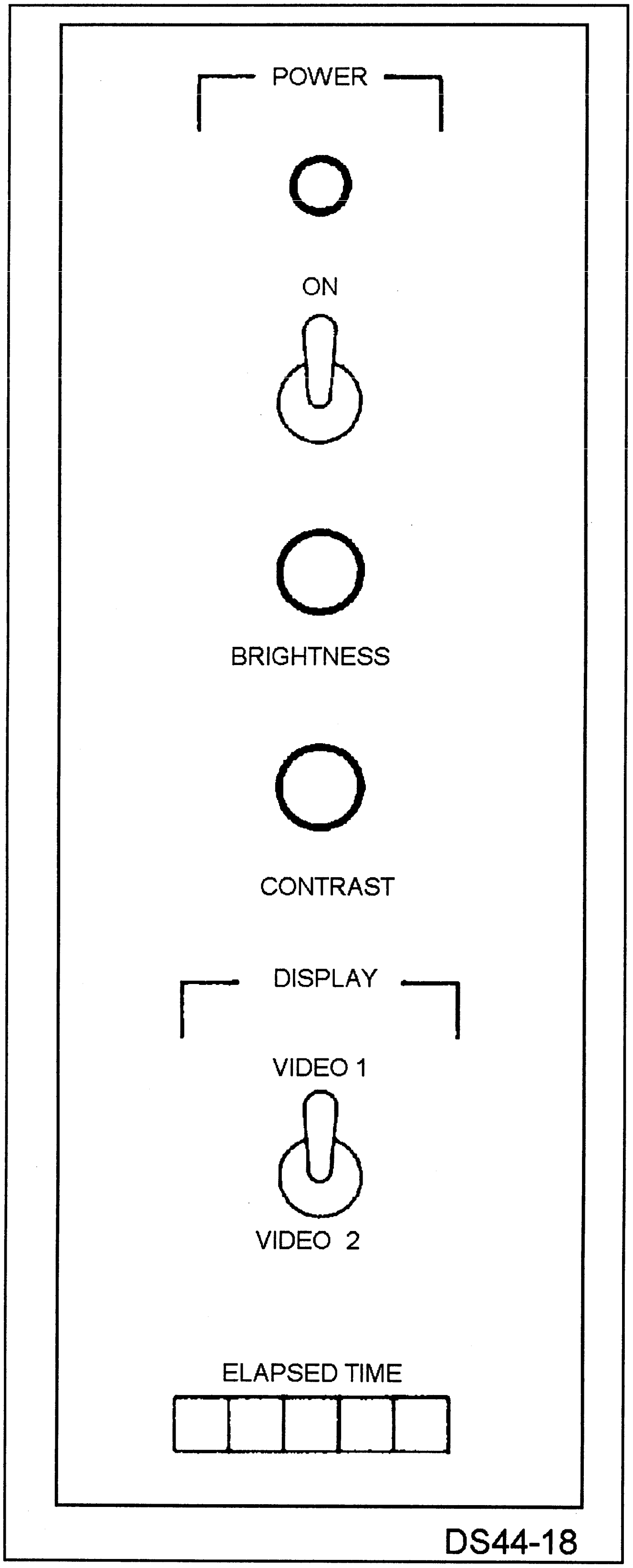

Figure 4-18.–The TV monitor control panel.

DIGITAL DISPLAY INDICATOR.— The digital data indicator is a high resolution video monitor with

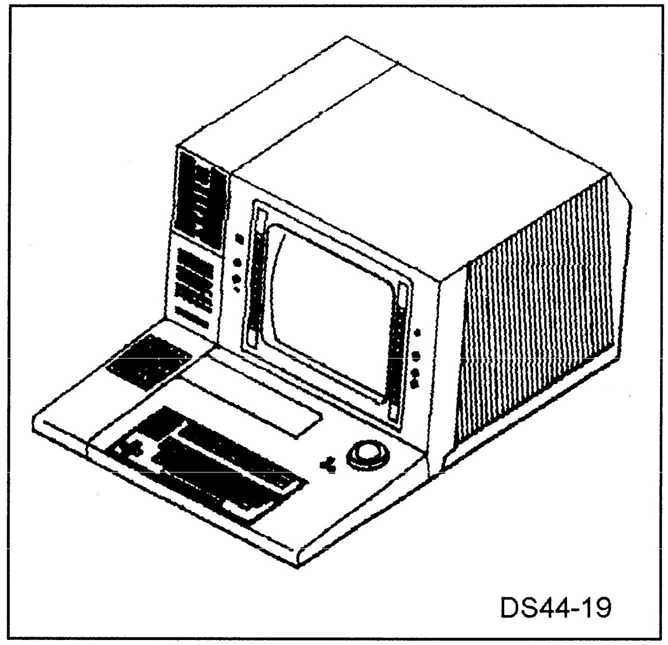

Figure 4-19.—A Display Control Console (DCC) OJ-535(V)/UYQ-21(V).

a 10" x 13" CRT. The digital display indicator displays alphanumeric data from either a computer or a keyboard and composite video graphics generated by the C-DITEG. The graphics monitor can display video in either a 525-line TV format or a 1075-line TV format. The graphics monitor has either 20 or 22 variable function keys (VFKs) to send data to the system computer. The graphics monitor has four functional areas: the monitor interface function, the monitor deflection function, the video amplifier function, and the power distribution function.

Monitor Interface Function.— The monitor interface function controls the communications between other functional areas of the graphics monitor, controls the interface between external equipments, and processes and distributes brightness, contrast, and video selection from the front panel controls.

The monitor interface function is controlled by the interface microprocessor. The interface microprocessor controls the two-way exchange of serial data between the graphics monitor and the C-DITEG. It also monitors the front panel switches and controls. If a VFK is depressed, the interface microprocessor forms the serial input word for

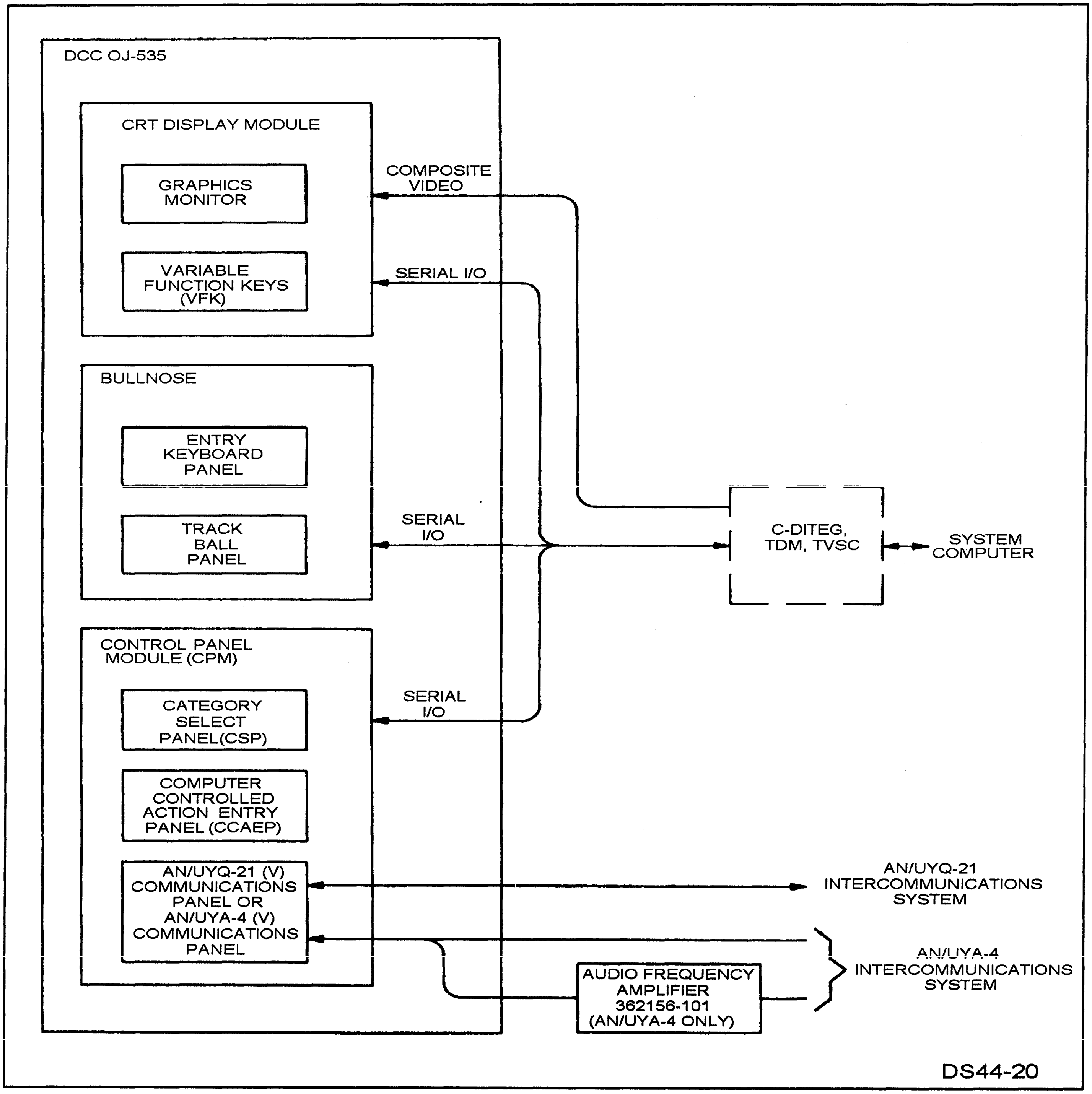

Figure 4-20.—The display control console interface block diagram.

transmission to the C-DITEG at the next interrogation.

Composite video from the C-DITEG or external video is processed by the monitor interface function. Video is selected by the VIDEO SELECT switch. The selected video is sent to the video preamp and amplified before being sent to the video amplifier function. The sync processor of the monitor interface function separates the horizontal and vertical components of the composite signal, detects the scan rate (525 or 1075 lines), and controls the aspect ratio.

Monitor Deflection Function.— The monitor deflection function of the DCC receives the vertical and horizontal sync signals from the monitor interface sync processor. These signals are used to develop the voltages necessary to drive the vertical and horizontal deflection coils on the CRT yoke. The monitor deflection function also produces dynamic focus voltages to control the focus of the CRT beam.

Video Amplifier Function.— The video amplifier function receives the selected video signal and develops the voltages necessary to drive the CRT cathode and control grid (grid 1).

GRAPHICS TERMINAL SHELF.— The graphics terminal shelf is located in the bullnose of the DCC and contains the trackball assembly and the data entry keyboard. The trackball and keyboard functions are controlled by the bullnose microprocessor and interface with the system computer through the C-DITEG. The bullnose microprocessor monitors the switches (trackball and keyboard) for any operator action, develops a serial I-data word, and sends it to the C-DITEG. The microprocessor program also receives O-data from the C-DITEG and processes it. The O-data contains commands to light various keys on the entry keyboard.

CONTROL PANEL MODULE.— The control panel module is located on the left side of the graphics monitor. Depending on the configuration and system, the control panel module can contain a variety of switch panels. There can be one or two CCAEPs, a 6 x 7 category select panel, and a communications station.

The control panel module also contains a microprocessor that controls the communication with the C-DITEG. The microprocessor program monitors the switches in the various panels for activity, stores any action, creates an I-data word, and transmits the I-data to the computer via the C-DITEG.

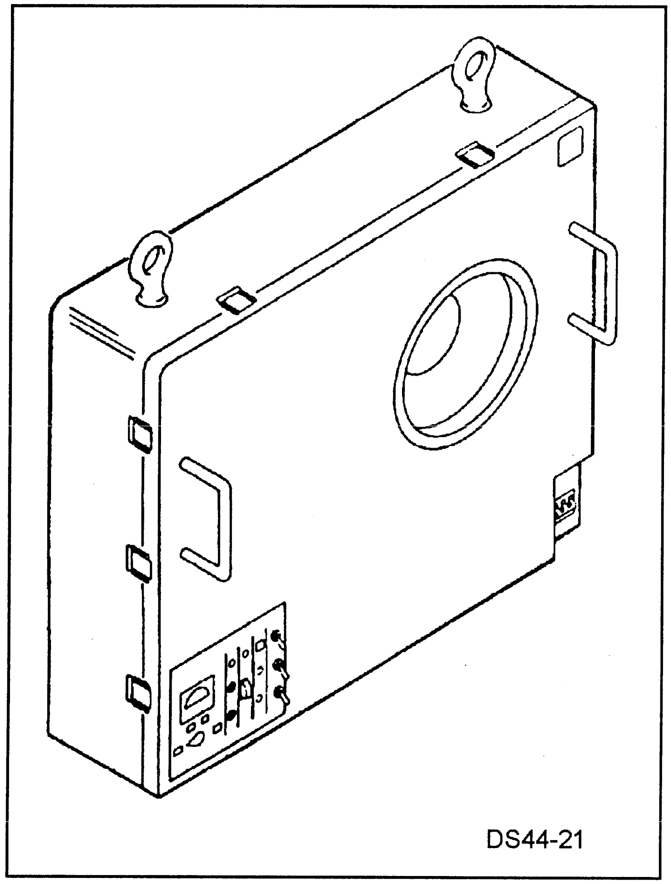

Figure 4-21.—The Projection Plotting Unit PT-525/UYQ-21(V).

PROJECTION PLOTTING UNIT PT-525/UYQ-21 (LARGE SCREEN DISPLAY)

Large screen display capability for the AN/UYQ-21(V) system is provided by the projection plotting unit (PPU), either the PT-525/UYQ-21(V) or

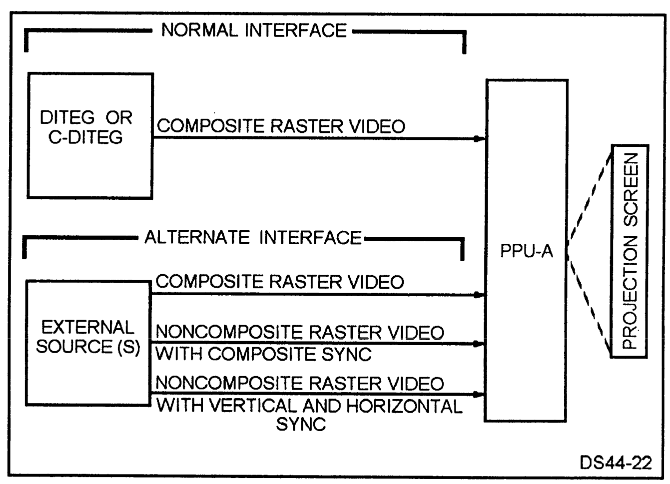

Figure 4-22.–The PPU interface options.

the PT-525A/UYQ-21(V). For our training purposes, we are using the PT-525/UYQ-21(V). The PPU is a large screen projection display device that projects a visual image onto a 42" x 42" screen. The presentation consists of yellow characters on a blue background. Display resolution can be 525, 729, or 1075 lines per frame. Figure 4-21 shows the PT-525/UYQ-21(V) unit.

The PPU receives composite video from the DITEG or C-DITEG. The PPU is also capable of displaying raster video from an external source if separate horizontal and vertical sync signals are provided. The PPU can also display random stroke video supplied by an OJ-451(V)2,3/UYQ-21 that is equipped with the display signal amplifier option. Figure 4-22 illustrates the interface options available.

The PPU consists of the following five functional areas:

- Video processing function
- Sweep and deflection function
- CRT function
- Projection function
- Power distribution function

Video Processing Function

The video processing function receives the incoming video and develops the video and blanking signals required to control the electron beam of the CRT. The video input can be composite video, noncomposite video with separate horizontal and vertical sync, or random stroke video. The video signal is amplified and used to drive the CRT cathode. The sync signals are processed to form the horizontal and vertical retrace blanking signals.

Sweep and Deflection Function

The sweep and deflection function develops the signals required to move the CRT electron beam. Raster deflection voltages are generated from the

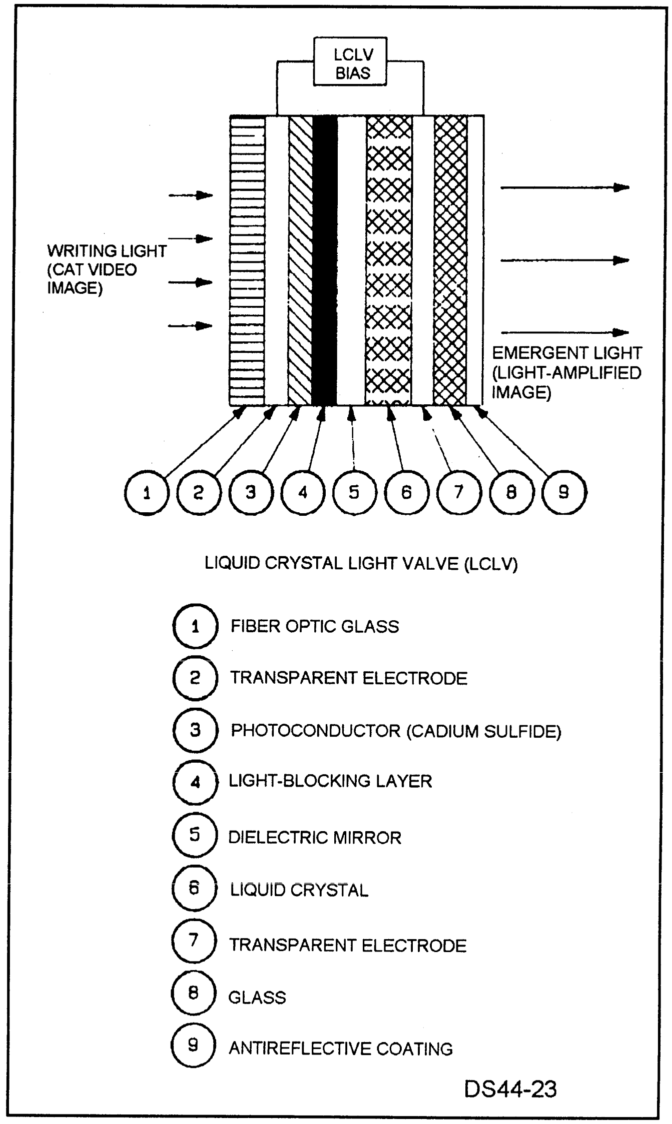

Figure 4-23.–A cross section view of the liquid crystal light valve.

horizontal and vertical sync signals received from the video processor function. Random stroke deflection voltages are received from the TDS display console in the form of X and Y major (position) deflection voltages and X and Y minor (symbol) signals. The deflection voltages are used to drive the yoke of the CRT.

CRT Function

The CRT function uses the video and deflection voltages to create a visual image. The CRT in the PPU is a 2.25-inch diameter, high resolution electron tube. The video output of the CRT is a fiber-optic faceplate. The faceplate is in physical contact with the fiber-optic substrate of the liquid crystal light valve (LCLV) in the projection function. The fiber-optic substrate of the LCLV acts as the interface between the CRT and the LCLV.

Projection Function

The projection function receives the visual image from the CRT, amplifies it, and projects it to a large screen. A 500-watt xenon arc lamp provides a high intensity light source to the LCLV. Figure 4-23 shows a cross section of a LCLV. The LCLV bias is a variable ac voltage used to align the liquid crystal molecules. When no light is present on the fiber-optic plate, the bias voltage drop is primarily across the photoconductor layer and not the liquid crysta1 layer. When a point of light hits the fiber-optic plate, the impedance of the photo conductor at that point will drop and the ac voltage will be applied to the corresponding point on the liquid crystal layer. A voltage drop on the liquid crystal causes the liquid crystal molecules to rotate and polarizes the light. The light emitted by the LCLV is polarized (rotated) in areas that had light applied to the LCLV and unaltered where there is no liquid crystal molecular rotation. This light is then processed by a series of optic lenses and prisms and projected onto the screen.

Power Distribution Function

The power distribution function develops and distributes the voltages required by the PPU. The low-voltage power supply develops regulated +5, +15, and -15 vdc. The medium voltage power supply develops +31, -31, +100, +110, and -110 vdc. The medium-voltage power supply also develops the +6.3 vac for the CRT filament.

The arc lamp power supply and lamp igniter provide the starting and operating voltages for the arc lamp. When power is applied, the arc lamp power supply sends +100 vdc to the arc lamp igniter. This voltage is used to start the arc lamp igniter, which steps up the 115 vac input voltage to a 24 kv, which is then sent to the arc lamp. If the arc lamp ignites, the +100 volts drops to 20 volts to maintain a constant current through the lamp. If the arc lamp does not ignite, the 24-kv ignition pulse will be repeated up to a maximum of 12 times. If ignition fails after 12 attempts, a lockout circuit will inhibit further attempts and light the lockout indicator on the power supply. The lockout circuit must be manually reset.

TELEVISION CONVERTER GROUP

The television converter group develops the composite video signals required to display graphics and alphanumerics on the OJ-535(V)/UYQ-21(V), the large screen displays, and the automated status boards (ASTABs). The television converter group can also be configured to drive hard-copy printer-plotters.

Depending on the ship's configuration, the television converter group will contain one or more of the following equipments:

1 Common digital television graphics generator (C-DITEG)

- Digital television graphics generator (DITEG)
- Dual television scan converter (dual TVSC)
- Tactical DITEG module (TDM)
- Central ASTAB generator

In our study of the television converter group, we look at the C-DITEG in detail and follow it with a brief description of the functions and capabilities of the other types of converters.

COMMON DIGITAL TELEVISION GRAPHICS GENERATOR (C-DITEG)

The common digital television graphics generator (C-DITEG) is used to generate the text, graphics, and symbols used in displays and hard-copy printer-plotters. The C-DITEG is a multichannel device that can drive up to 14 displays and 2 hard-copy printer-plotters. Of the 14 displays, 8 are graphic display units and 6 are text-only units. The 8 graphic displays are 6 display consoles, (OJ-535(V)/UYQ-21(V)), and 2 large screen displays (PT525/UYQ-21(V)). The

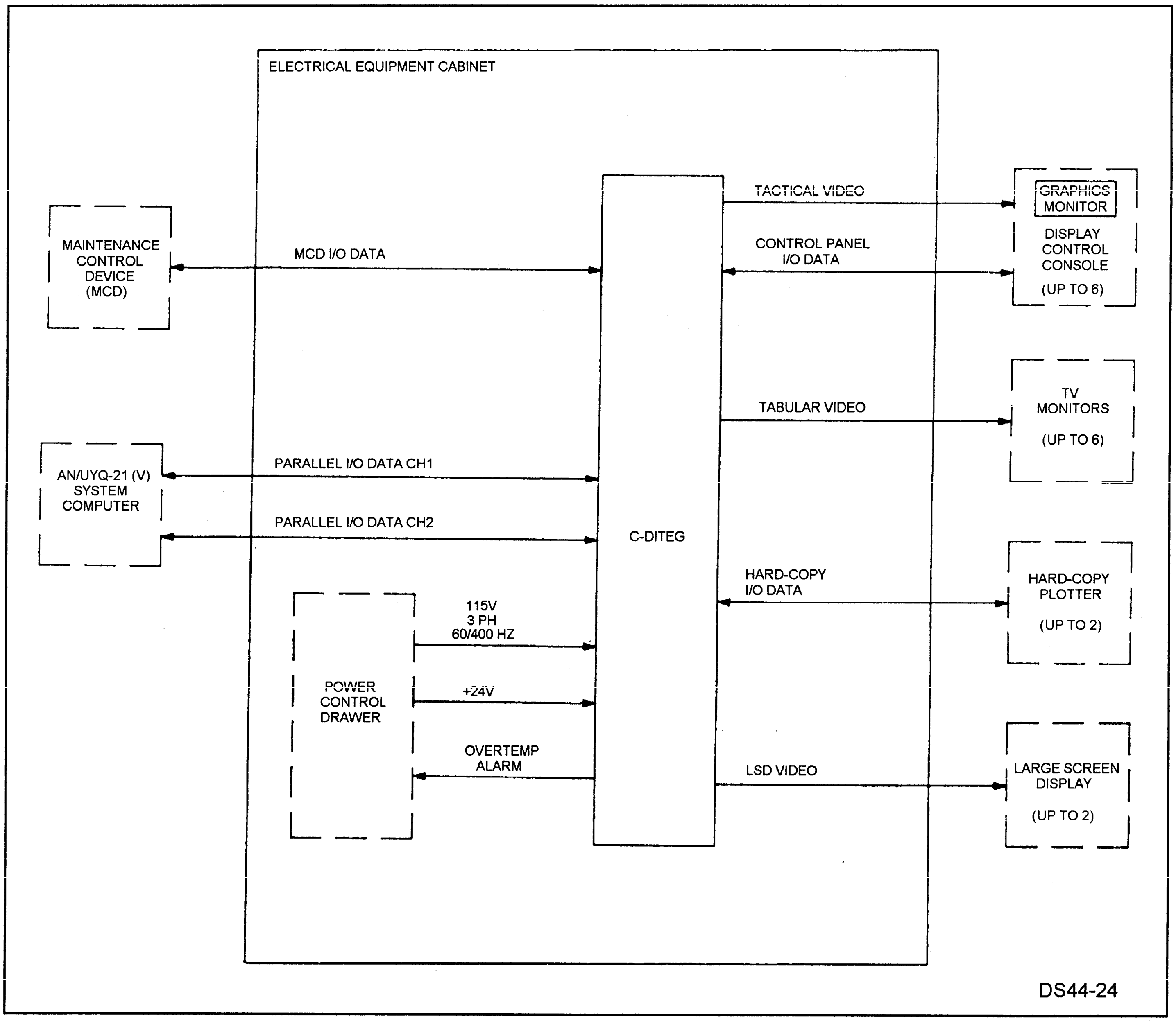

Figure 4-24.—C-DITEG interface options.

CRT screens of all 14 of the displays can be copied onto either of the hard-copy printer-plotters. The C-DITEG also provides the interface between the system computer and the DCC switch panels. The C-DITEG cannot generate radar sweep and video for display on the CRT. Figure 4-24 illustrates the interface options of the C-DITEG.

The C-DITEG consists of two AN/UYQ-21(V) electronics drawers. These are the processor drawer and the video drawer. The drawers must be mounted adjacent to each other, either horizontally or vertically, in a standard six-drawer electronics cabinet or in a two-drawer electronics cabinet.

C-DITEG Processor Drawer

The C-DITEG processor drawer provides the interface between the system computer and the display consoles, converts computer data into display data and commands, generates tabular video, and processes the bit map memory addresses for the video drawer. The processor drawer consists of the following functions:

- O-data receivers
- Input/output (I/O) controller
- Control synchronizer
- System memory
- Peripheral input/output
- Formatter
- Function generator
- Tabular video generator
- I-data transmitters

O-DATA RECEIVERS.— The O-data receivers accept 32 bits of parallel computer data, provide the proper level shifting, and send the computer data to the I/O controller.

INPUT/OUTPUT CONTROLLER.— The input/output (I/O) controller manages the communication with the system computer. The I/O controller receives computer data through the O-data receivers and sends data to the computer through the I-data transmitters. There are two identical I/O channels in the C-DITEG, although only one maybe active at any time. Channel 0 is the default channel; and if the active channel fails, the normally idle channel will become active.

The I/O controller decodes incoming computer data for C-DITEG control words or display data words. Display data is sent to system memory.

CONTROL SYNCHRONIZER.— The control synchronizer uses four crystal oscillators to generate the system clocks. The crystal oscillators generate 40-MHz, 27-MHz, 24-MHz, and 16-MHz clocks. The 40-MHz clock is divided by two and four to generate 50-nanosecond and 100-nanosecond clock pulses. The 27-MHZ clock is divided by 16 to become the universal asynchronous receive/transmit clock. The 24-MHz and 16-MHz clocks are divided by two to become the video format pixel clocks.

The control synchronizer also produces the synchronization and timing signals for the three tabular (text only) video formats. These video formats are: 40 x 80 x 9 (40-line x 80-column x 9-pixel character width), 40 x 80 x 8, and 16 x 48 x 9.

SYSTEM MEMORY.— The system memory fiction consists of 512K of random access memory (RAM) and 192K of erasable, programmable read-only memory (EPROM). The RAM is used for temporary data storage (file memory). The EPROM contains the operational firmware required by the C-DITEG. If the C-DITEG has field change 3 installed, the RAM is increased to 1M.

PERIPHERAL I/O FUNCTION.— The peripheral I/O (PIO) function interfaces the external peripherals with the C-DITEG. The peripherals are up to two hard-copy printer-plotters, up to six TV monitors, up to six display control consoles (DCCs), and up to two large screen displays (LSDs). The PIO function also generates data and control signals for the tabular video generator. The PIO function also interrogates the display control consoles for any switch actions. If a switch action has occurred, the switch data is received from the DCC by the PIO, reformatted, and transferred to the system computer, via the system memory, by the I/O controller. The PIO also sends the signals to control the lighting of the lamps on the DCC control panels.

When a hard-copy printout is requested, the PIO obtains the data from the video drawer's bit mapped memory, reformats the data for the printer-plotter, and sends the data to the printer plotter.

FORMATTER.— The formatter generates formatted display data for the display control console graphics display, large screen display, and the hard-copy printer-plotter from file memory data. The formatter also produces the control signals for the function generator of the processor drawer and the bit map memory of the video drawer.

FUNCTION GENERATOR.— The function generator creates display data consisting of conies (circles and ellipses), vectors, and characters from formatted data received from the formatter. This display data is sent to the video drawer in the form of pixel data for the generation of DCC and large screen displays.

TABULAR VIDEO GENERATOR.— The tabular video generator forms the composite video signals to display text data on six TV monitors. The tabular video generator can create video in one of three video formats. The video formats are 40 x 80 x 9, 40 x 80 x 8, and 48 x 16 x 9. The character information to be displayed is received from the PIO data and address buses, converted to a video bit stream and then to the analog composite video signal that is sent to the TV monitors.

I-DATA TRANSMITTERS.— The I-data transmitters interface the system computer with the I/O controller. The I-data transmitters receive computer input data from the I/O controller and level shift the data for transmission over the system I/O cables.

C-DITEG Video Drawer

The C-DITEG video drawer receives the formatted video data from the processor drawer and generates the composite video signals for the display control console and large screen displays. Display data for hard-copy display is sent from the video drawer to the processor drawer. The video drawer is capable of driving six display control consoles and two large screen displays. The video drawer consists of the following functional areas:

- Timing synchronizer
- Bit map memory and control function
- Video multiplexer
- Tactical video generator

TIMING SYNCHRONIZER.— The timing synchronizer generates the clocks, sync signals, blanking signals, and shift controls needed by the video drawer for video generation.

BIT MAP MEMORY AND CONTROL FUNCTION.— The bit map memory and control function consists of 44 or 48 1024 x 1024-bit Cartesian coordinate memory planes. Video drawers with field change 2 installed have 48 memory planes. These memory planes store the images that are to be displayed on the DCC and LSD. Images are written on the memory plane by the processor drawer using the same coordinates as if they were being displayed on a screen. The display data is read out of the memory planes as serial bit streams and sent to the video multiplexer for eventual display.

VIDEO MULTIPLEXER.— The video multiplexer receives the 48 bit streams from the bit map memory and creates serial data streams for use by the tactical video generator. The video multiplexer also provides the data for a hard-copy printout to the processor drawer.

TACTICAL VIDEO GENERATOR.— The tactical video generator converts the data streams from the video multiplexer into composite video. The tactical video generator can generate color video for six color tactical display channels and two monochrome large screen display channels. Color is not currently used in the AN/UYQ-21(V) system and the six tactical color outputs normally drive the OJ-535(V)/UYQ-21(V) display control consoles.

Pixel data from the data streams and sync signals from the timing synchronizer are combined in the tactical video generator to produce a composite video output. The video output is modified for 1075 lines per screen with 1024 displayable lines. There are two modes of video output for the tactical video channels: 1024 pixels per line or 1280 pixels per line. In the 1280 pixel per line mode, the additional 256 pixels are used to paint the VFK labels on the DCCs. The LSD video is always output in the 1024 pixel per line mode.

DIGITAL TELEVISION GRAPHICS GENERATOR (DITEG)

The digital television graphics generator (DITEG) is an electronics drawer that provides the circuitry required to display graphics data on a single PPU or DCC. One DITEG can drive one PPU. In addition, the DITEG provides the interface for ball tab information from a DCC to be displayed on the DITEG display screen. The DITEG generates the composite video for display on the PPU in a manner similar to that described for the C-DITEG.

DUAL TELEVISION SCAN CONVERTER (DUAL TVSC)

The dual television scan converter (dual TVSC) mixes radar sweep and video with graphics video to provide the DCC with aradar and tactical symbol display. The dual TVSC is housed in a single standard AN/UYQ-21(V) electronics drawer. Each dual TVSC is capable of driving two DCCs and there are two-dual TVSCs per six-drawer electronics cabinets. Additional cabinets are added as dictated by system requirements.

The dual TVSC receives radar sweep and video data directly from the SDDS. The radar azimuth, range, and video data is processed by the dual TVSC into a high resolution composite video signal. Composite video from the C-DITEG is received by the dual TVSC, synchronized, and merged with the radar video to produce a single high resolution raster scan output for display on the DCC.

TACTICAL DITEG MODULE (TDM)

The tactical DITEG module (TDM) contains the features of the TVSC and C-DITEG and is designed to drive one OJ-535(V)/UYQ-21(V) display control console, one TV monitor, and one hard-copy printer-plotter.

The DITEG module of the TDM receives data from the system computer and processes the symbol data into a high resolution composite video signal that is sent to the TVSC function. Tabular, or text data, is processed into a low resolution composite video signal for display on the TV monitor. The DITEG module also contains the circuitry required to drive a hard-copy printer-plotter.

The TVSC module of the TDM receives radar video, azimuth, and range data from the SDDS and tactical composite video data from the DITEG module. The TVSC converts the radar data into a raster scan composite video signal, merges it with the tactical composite video, and sends it to the DCC for display.

CENTRAL AUTOMATED STATUS BOARD GENERATOR (CAG)

The central automated status board generator (CAG) converts computer-supplied alphanumeric data into a low-resolution (525 line) composite video signal for display on a standard TV monitor. The CAG can simultaneously drive 16 monitors. The data displayed on the automated status board (ASTAB) monitors is selectable from a display console or a remote keypad mounted near the ASTAB monitor.

The CAG can also accept video inputs from a maximum of eight TV cameras. The CAG generates the horizontal and vertical synchronizing signal or composite video signals needed to control the external cameras.

SUMMARY-COMPUTER DISPLAY SET AN/UYQ-21(V)

This chapter has presented material on the Computer Display Set AN/UYQ-21(V). The following information summarizes important points you should have learned.

CENTRAL EQUIPMENT GROUP (CEG)— The CEG contains the central data buffer (CDB), sensor converter group, and the sensor data distribution switchboard (SDDS). These equipments interface the tactical display consoles with the computer and ship's sensors.

CENTRAL DATA BUFFER (CDB)— The CDB converts parallel data from the computer to serial data, and distributes the data to the TDS display console. The CDB receives serial data from the consoles, converts the data to parallel, and sends it to the system computer.

SENSOR CONVERTER GROUP–The sensor converter group is the main interface between the ship's sensors and the display consoles. Common converters are the synchro radar azimuth converter (SRAC) and the digital radar azimuth converter (DRAC). These converters generate the signals required to display sweep and range marks on the display console.

SENSOR DATA DISTRIBUTION SWITCHBOARD (SDDS)— The SDDS consists of two drawers in the CDB, the sweep drawer and the video switching drawer. The SDDS can route sensor data from 12 sensors to 20 display consoles.

DISPLAY CONSOLES— The Computer Display SET AN/UYQ-21(V) uses several types of display consoles, depending on the configuration of the system in which the consoles are installed. These consoles include the TDS Display Console OJ-451(V)/UYQ-21(V), the Display Control Console OJ-535(V)/UYQ-21(V), and the Projection Plotting Unit PT-525/UYQ-21(V).

TDS DISPLAY CONSOLE OJ-451(V)/UYQ-21(V)— The TDS display console is the main operator interface with the operational program in a tactical system. The TDS display console can display sweep, video, and computer-generated symbols. The TDS display console consists of the computer display console, the basic display unit, and a TV monitor. The TDS display console uses a vector scan CRT.

DISPLAY CONTROL CONSOLE (DCC) OJ-535(V)/UYQ-21(V)— The DCC is the main operator interface in the command and control subset of the AN/UYQ-21(V) system. The DCC consists of three modules: the digital data indicator (CRT display module), graphics display shelf (bullnose), and the control panels. The DCC interfaces with the system computer through a television converter. The DCC CRT is a raster scan CRT. Sensor sweep and video are not normally displayed on the DCC.

PROJECTION PLOTTING UNIT (PPU) PT-525/UYQ-21(V)– The PPU is a large screen display that projects computer-generated symbols on a 42 x 42-inch screen.

TELEVISION CONVERTER GROUP— The television converter group develops the composite signals needed to display graphics and alphanumerics on the DCC, PPU, and automated status boards. The television converter group can also drive the hard-copy printer-plotters used in the AN/UYQ-21(V) system. Depending on the system configuration, the television converter group will have one or more of the following: common digital television graphics generator (C-DITEG), digital television graphics generator (DITEG), dual television scan converter (Dual TVSC), tactical DITEG module (TDM), and a central automated status board generator (CAG).

COMMON DIGITAL TELEVISION GRAPHICS GENERATOR (C-DITEG)— The C-DITEG is a multichannel device that can drive up to six DCCs, two PPUs, eight text-only displays, and two hard-copy printer-plotters. The C-DITEG generates the composite video required to display symbols, graphics, and text on the DCC and PPU. The C-DITEG develops a tabular video for text-only display (TV monitor). It also provides the interface between the DCC switch panels and the system computer.

DIGITAL TELEVISION GRAPHICS GENERATOR (DITEG)— The DITEG provides the display for a single PPU or DCC. The DITEG operates in a manner similar to the C-DITEG in the generation of the tactical video for display on the PPU or DCC.

DUAL TELEVISION SCAN CONVERTER (DUAL TVSC)— The DUAL TVSC mixes radar sweep and video signals with the tactical symbols into a single raster scan composite video signal for display on the DCC.

TACTICAL DITEG MODULE (TDM)— The TDM combines the features of the dual TVSC and the C-DITEG to drive one display control console, one TV monitor, and one hard-copy printer-plotter.

CENTRAL AUTOMATED STATUS BOARD (ASTAB) GENERATOR (CAG)— The CAG converts computer-generated alphanumeric data into a composite video signal. The CAG can drive up to 16 TV monitors simultaneously.